Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

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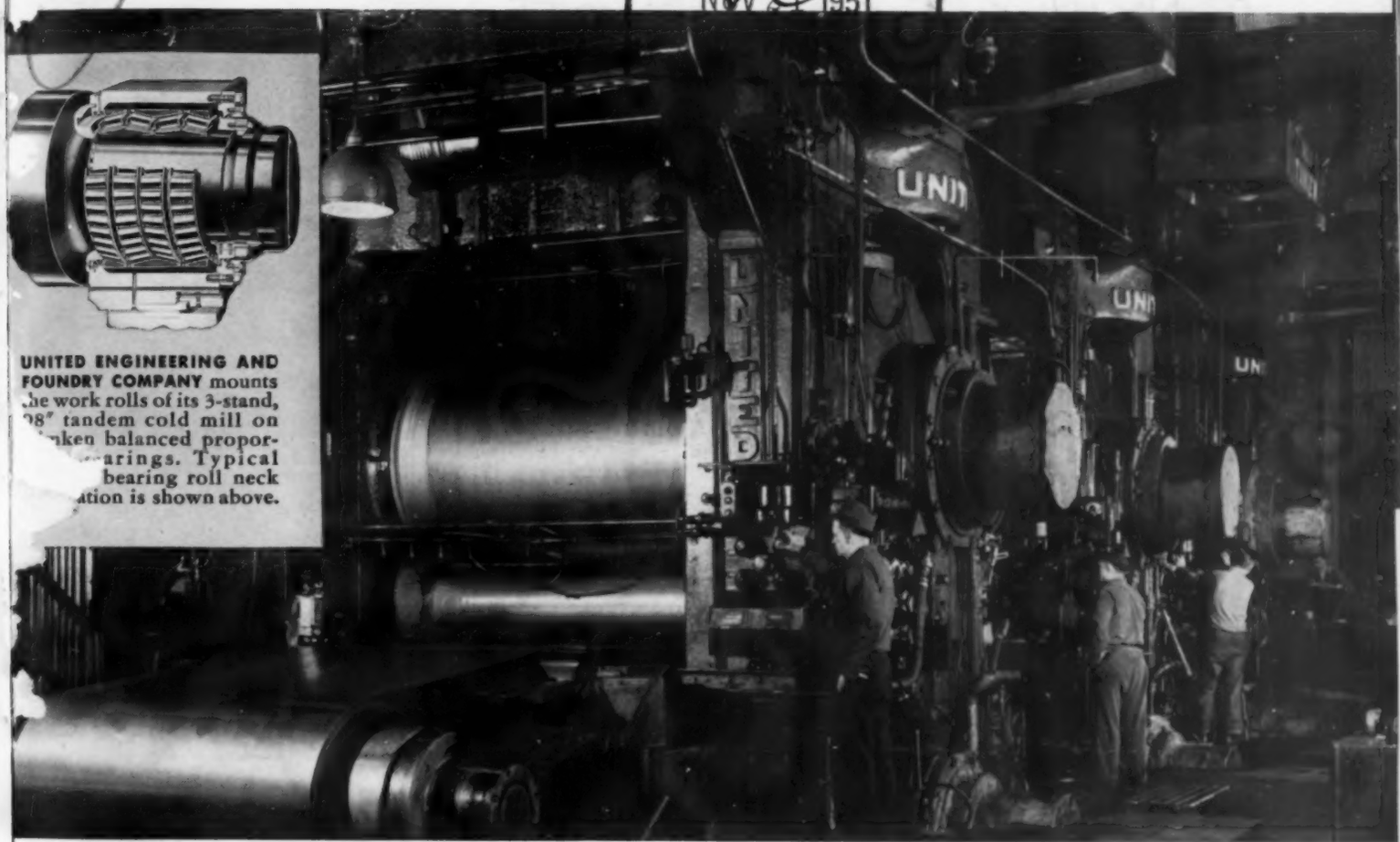


UNITED ENGINEERING AND FOUNDRY COMPANY mounts the work rolls of its 3-stand, 98" tandem cold mill on Timken balanced proportion bearings. Typical bearing roll neck location is shown above.

Reduces costs while it reduces gauge with help of TIMKEN® bearings

THE 3-stand 98" tandem cold mill shown above is reducing the gauge of wide strip steel from .100 to .035. Built by United Engineering and Foundry Company, the mill is designed to roll steel at maximum speed and minimum cost. One way United insured this was to mount the work rolls on Timken® tapered roller bearings.

Timken balanced proportion bearings provide greater mill rigidity because they permit larger diameter roll necks. Roll neck strength is increased 50 to 60%. Load ratings are upped as much as 40%.

High rolling mill speeds are possible. Wear on roll necks is minimized. Because Timken bearings permit mills to start smoothly and easily under full loads, they can be stopped and restarted without loss of steel. Gauge setting is not disturbed—no time wasted resetting rolls.

Timken bearings eliminate complicated lubrication systems, permit the use of simple and economical grease lubrication. Rolls can be changed quickly and easily. No special thrust bearings are needed because Timken bearings take radial and thrust loads in any combination.

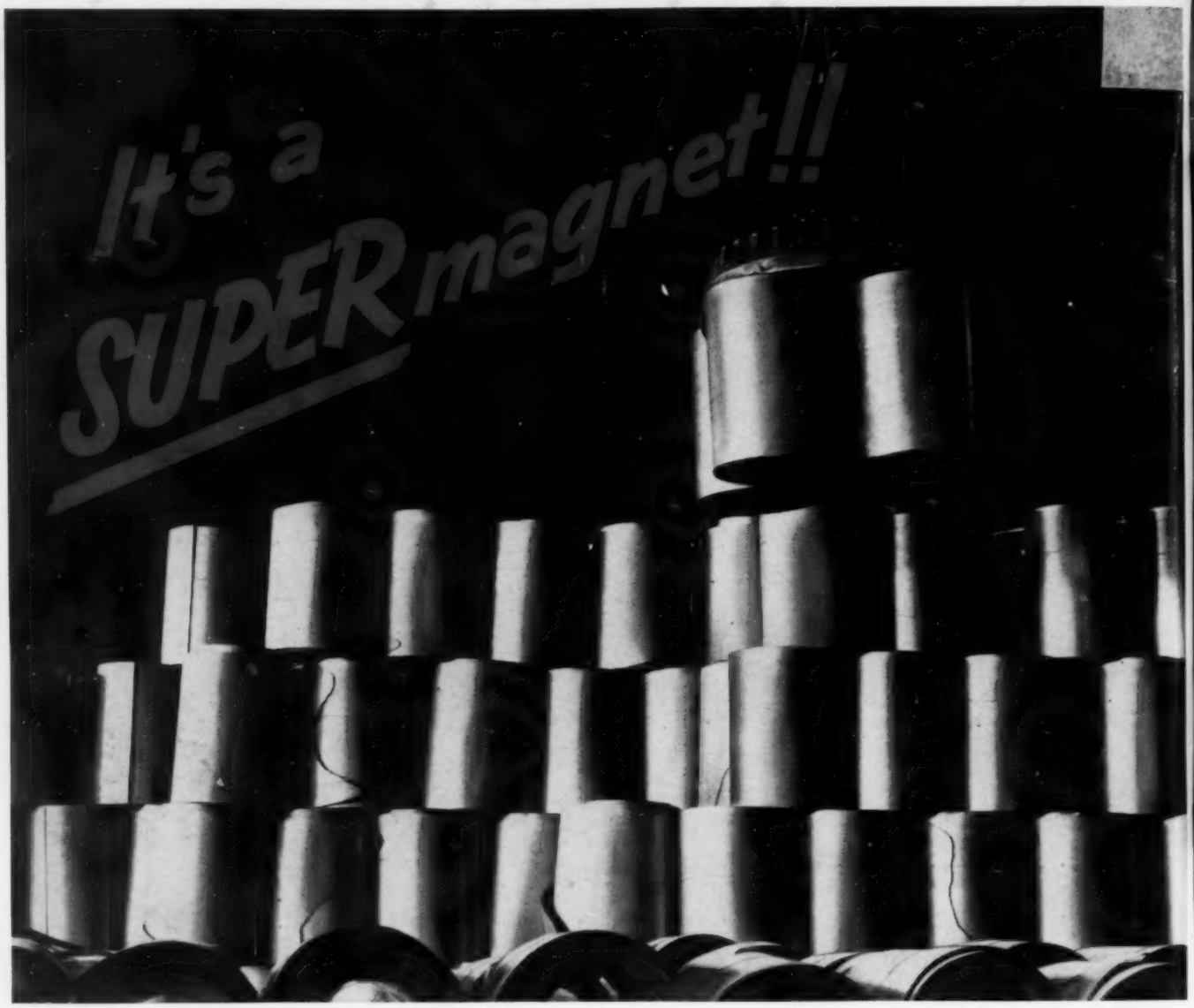
For full information consult our roll neck bearing specialists. Write The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◎ AND THRUST →◎← LOADS OR ANY COMBINATION →✳←



Its record proves what its construction promises

Men who have operated Cutler-Hammer Lifting Magnets during the past 50 years know their record. In steel mills, scrapyards and foundries . . . on railroads, ships and docks these Magnets have earned a reputation for dependable performance day after day, year after year, with little time out-of-service.

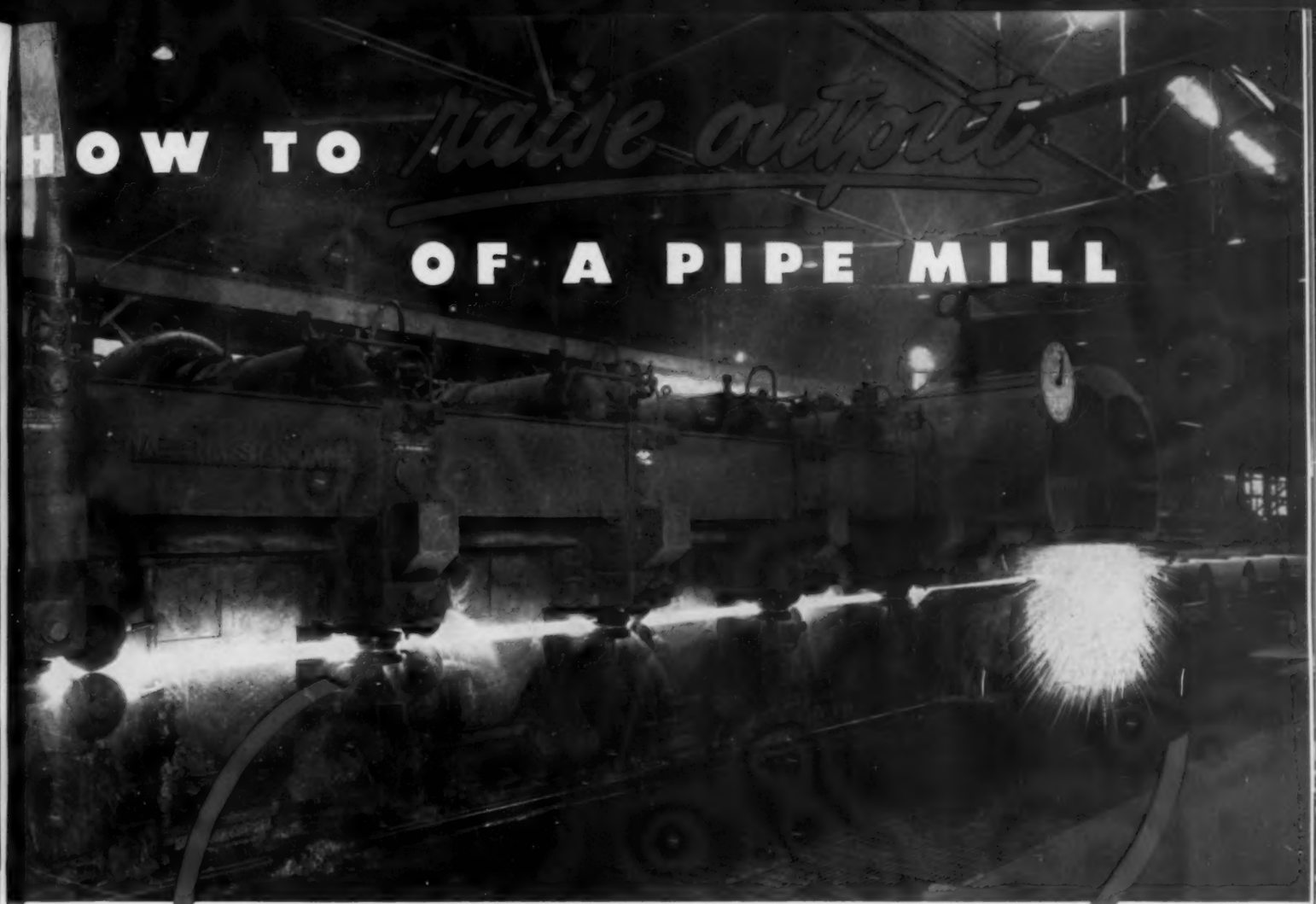
Any electrical engineer can tell you the secret of these Magnets' lifting power. It's in the coil, and in the construction. The makers of Cutler-Hammer Supermagnets wind the coils under tension to provide maximum copper density. They vacuum-impregnate the coils with a special compound, then bake the coils to form a solid monolithic mass and insure against air pockets. They sheath this solid mass in a welded sheet-steel housing. That makes coil moisture troubles a thing of the past. They build the body of dynamo steel to add lifting power. They make the pole shoes out of tough alloy that resists wear and adds strength. They double seal the terminal box to make it watertight. And they have designed a yoke that keeps chains separate and stops twisting. That adds to chain life.

CUTLER-HAMMER
SUPERMAGNETS
C-H

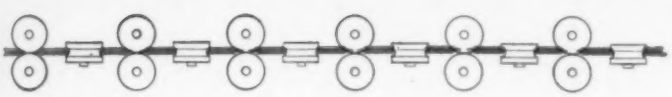
These are just some of the features that make Cutler-Hammer Supermagnets the preferred choice wherever iron and steel are handled. Users *know* these facts. You can learn them for yourself by specifying Cutler-Hammer the next time you buy a magnet. CUTLER-HAMMER, Inc., 1257 St. Paul Avenue, Milwaukee 1, Wisconsin.

IRON AND STEEL ENGINEER; published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress, March 3, 1879. $7.50 per year in United States and Canada, $10.00 foreign countries. Volume 28, No. 11

HOW TO *raise output* OF A PIPE MILL



Since Aetna-Standard announced the new super-speed Hot Saw less than two years ago, three installations have been completed, and six are in the construction stage.



● When Aetna-Standard developed a new super-speed Hot Saw last year, the industry predicted that speed and output of pipe mills in existence could be stepped up considerably. Here's a recent example. To increase the speed of a Continuous Butt Weld Pipe Mill, Aetna-Standard added 6 stands to the original 6 for a total of 12 stands. This increased the speed from 570 ft. to 750 ft. per minute but would have been useless without the new Hot Saw.

● The Aetna-Standard Hot Saw cuts pipe on this mill continuously in pre-determined lengths from 18 ft. to 54 ft., sizes of ½" to 1½". Equally important to the increased production, according to the operating officials, has been the improvement in tolerance. The new Hot Saw cuts to much closer tolerances at 750 ft. per minute than the old saw did at 500 ft. per minute.

If you are interested in rejuvenating your pipe mills, consult the pipe mill people—Aetna-Standard.

...if you are interested in rejuvenating your pipe mills, consult the pipe mill people

aetna-standard

THE AETNA-STANDARD ENGINEERING COMPANY • PITTSBURGH, PA.

Plants in Warren, Ohio • Ellwood City, Pennsylvania

ASSOCIATED COMPANIES

Head Wrightson Machine Company, Ltd., Middlesbrough, England—Great Britain, Finland, Sweden, Norway, Denmark, Union of South Africa, Northern and Southern Rhodesia.

Aetna-Standard Engineering Company, Ltd., Toronto, Ontario, Canada.

M. Castellvi, Inc., New York, N. Y.—Mexico, Central and South America.

Societe de Constructions de Montbard, Paris, France—France, Belgium, Holland, Luxembourg, Switzerland.

Demag Aktiengesellschaft, Duisburg, Germany—Germany, Austria, Yugoslavia, Greece, Turkey, Egypt.

Compagnia Italiana Forme Acciaio, Milano, Italy—Italy.

Aetna-Japan Company, Ltd., Tokyo, Japan—Japan.

Hale & Kullgren, Inc., Akron, Ohio—Representative for the Rubber Industry.

Designers and Builders to the Ferrous, Non-Ferrous, Leather and Rubber Industries

BROOKS 75th

OUR BIGGEST YEAR

IN THE PRODUCTION OF HIGHEST QUALITY LUBRICANTS FOR THE "TOUGH JOBS" OF INDUSTRY

—lubrication of open gears —wire rope—hydraulic systems —rolling mill screw downs —mill tables—mill pinions —enclosed gears—flexible couplings—circulating oil systems—worm gear drives, etc.

THE BROOKS OIL CO.
1876 1951
75th ANNIVERSARY

Anniversary

LEADOLENE
Klingfast

The superior quality "IP"* lubricant has made Brooks progress possible

Years ago Brooks established the policy of concentrating 100% of its research, engineering and production efforts on one thing . . . the compounding of industrial lubricants. We feel that is one reason why we are now celebrating the greatest year in our 75-year history. This policy of specialization . . . which led to the development of LEADOLENE KLINGFAST, the lubricant with the "indestructible pH-ilm" . . . has permitted us to grow to a position of leadership in the field of industrial lubrication.

Although constantly growing in size, and now among the largest compounders of industrial lubricants in the world, Brooks has remained an "intimate service" organization. Every Brooks installation is engineered by a representative who is first an experienced lubrication authority and then a well-trained salesman, capable of giving you the technical counsel you may require.

WRITE TODAY FOR FREE SAMPLE

Describe your most difficult lubrication problem, and Brooks will supply a generous sample of a lubricant specially compounded to do your job best.

*I.P. . . . the lubricant with "indestructible pH-ilm," capable of withstanding pressures up to 50,000 psi.

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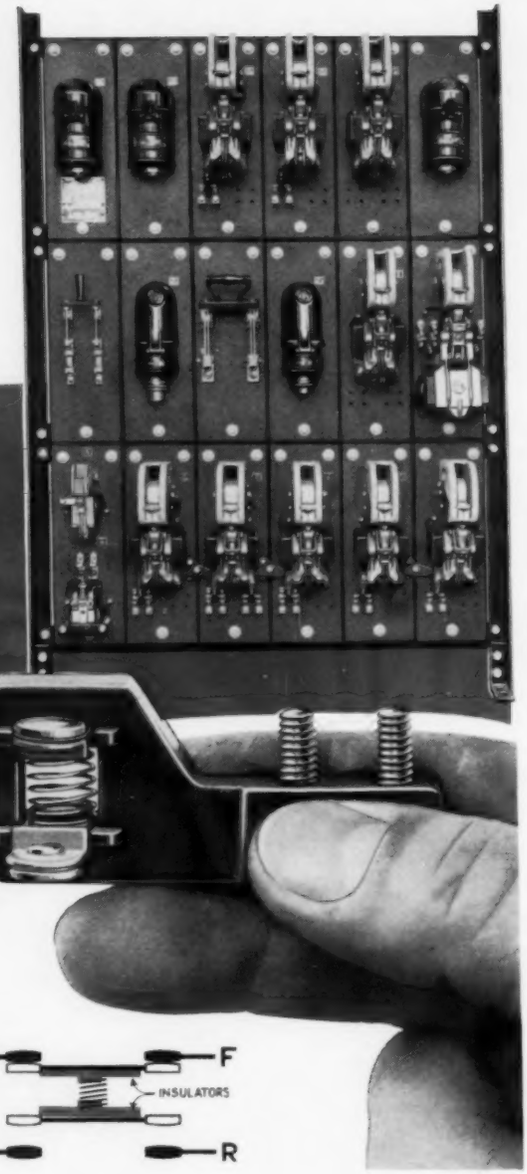
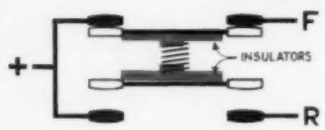
8 *Important Features of* **EC&M** *Magnetic Control*

1 Time-Current Acceleration
2 Line-Arc Contactors
3 Wright Hoist Circuit
4 Tab-Weld Resistors
5 Cam Master Switches
6 Safer Electrical Interlocks ✓
7 Bolted, Welded Frame
8 Quick Contact Renewing

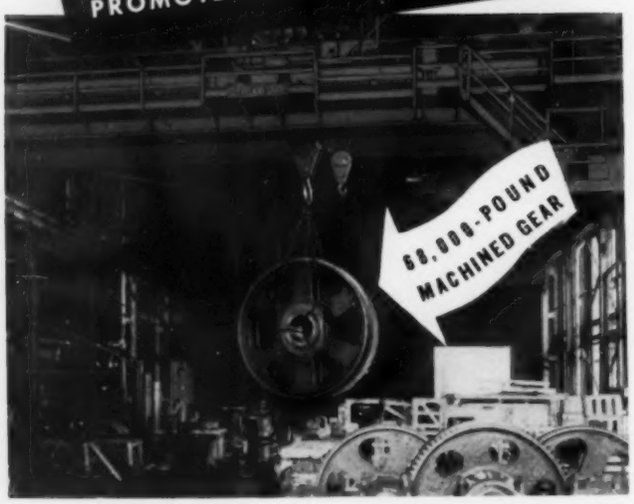
simpler, safer ELECTRICAL INTERLOCKS on all EC&M improved *LINE-ARC* CONTACTORS



Two sets of double-break contacts—*isolated from each other*—no carry-over from one to the other by an arc.



EFFICIENT INTERLOCKING PROMOTES EFFICIENT OPERATION



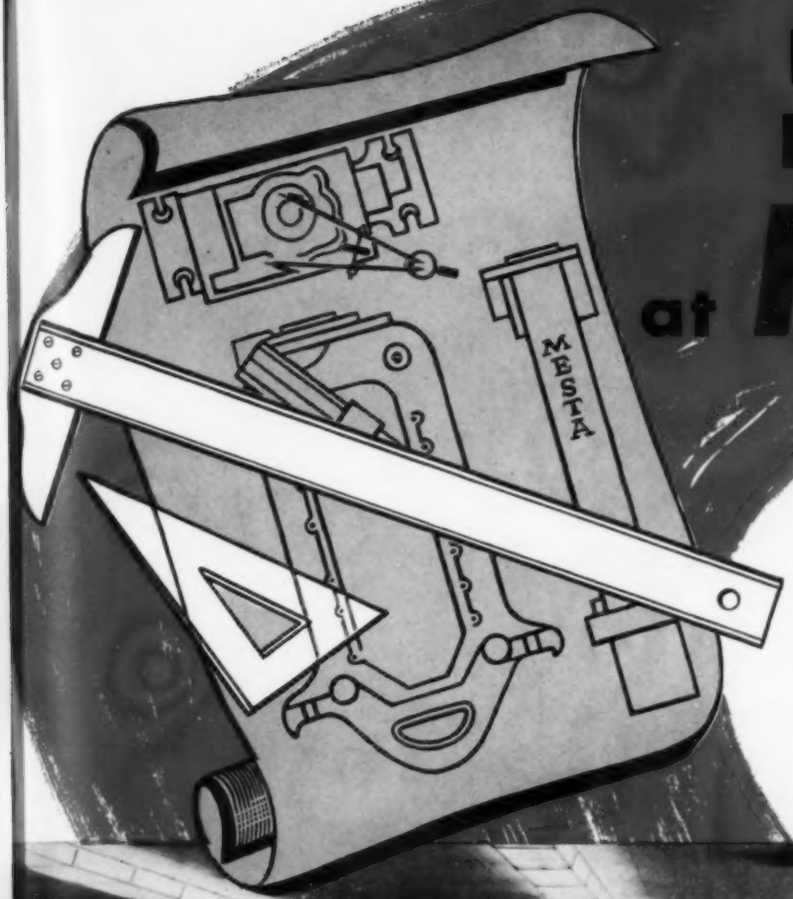
These EC&M Electrical Interlocks are unequalled—the movable coin-silver contacts are carried in the window-frame or rectangular slot of the insulator which is attached to the front of the contactor-arm by two screws as shown. These movable contacts engage or bridge the stationary contacts, also of coin-silver.

Note that the moving-contact assembly uses two duplicate bridges, held in position by a common spring. Each bridge is backed up with a combined insulator-spring-retainer—the spring cannot conduct current from one bridge to the other.

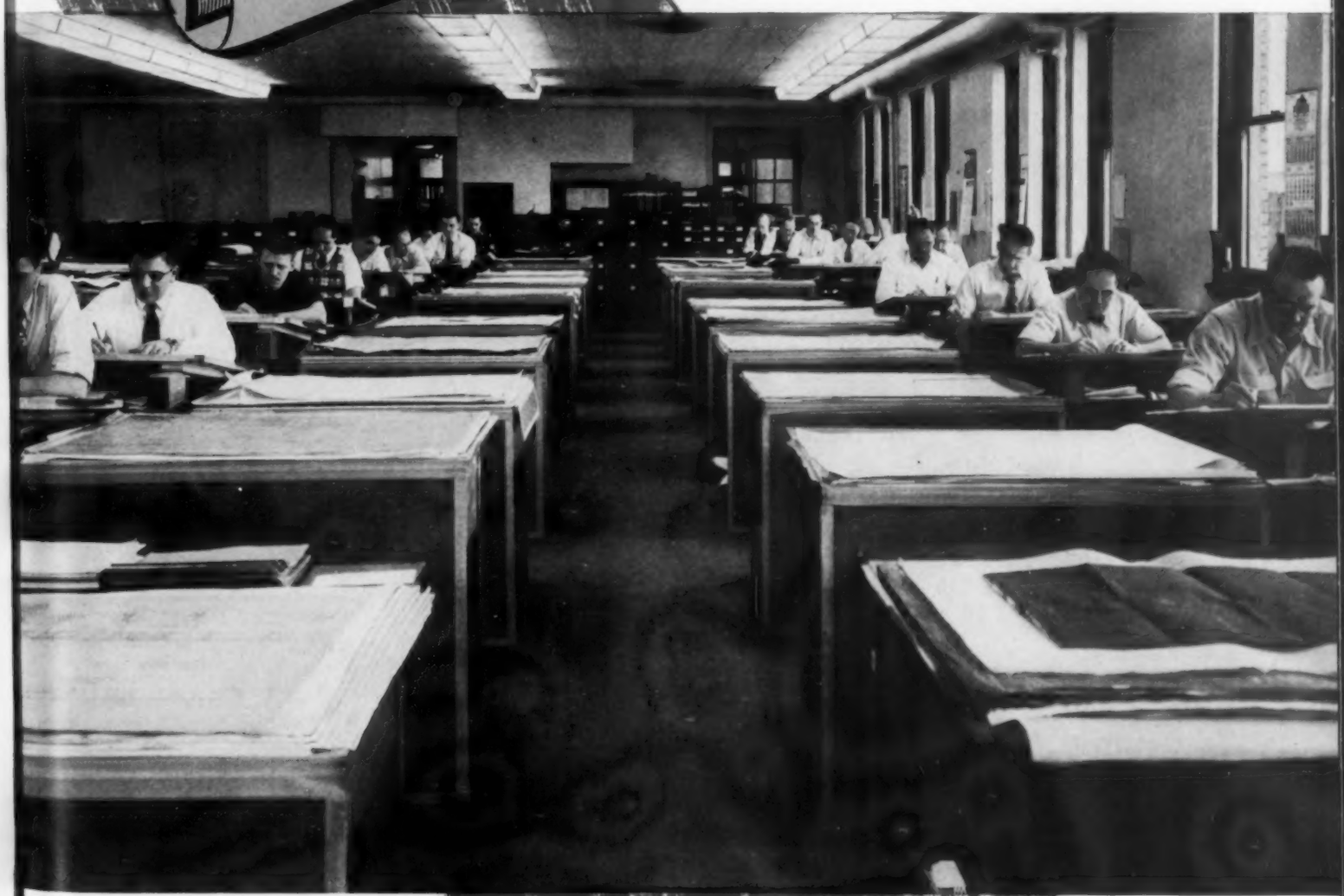
With these improved interlocks, the n.o. circuit is isolated from the n.c. circuit—interlocking is simple, safe—a good reason for specifying EC&M *LINE-ARC* Contactor Control for cranes and mill auxiliaries.

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

ENGINEERING DEPARTMENTS at MESTA



A section in one of the Mesta Engineering Departments, where machinery to fit individual requirements is designed and plans for complete plant projects are developed. These include not only designs for the mechanical equipment built by Mesta, but also for buildings, foundations, electrical distribution systems, and all the engineering that is required for the creation of a modern industrial plant.



Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY

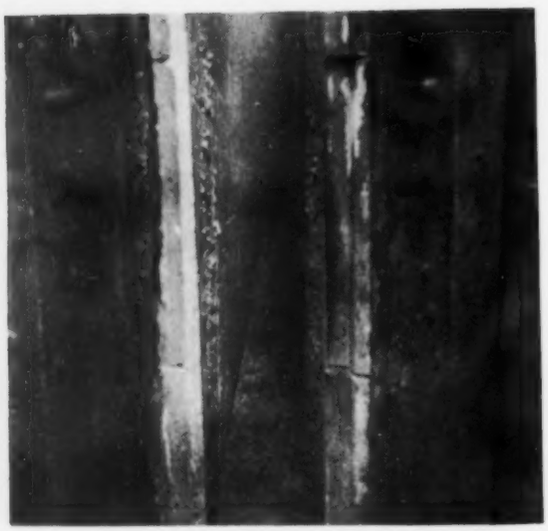
PITTSBURGH, PENNSYLVANIA

No Refractory Cement Ever Like It for Bonding or Patching

the Brickwork in Linings, Settings, Floors, Doors, Arches, Baffles, Jambs

in Coke Ovens, Blast Furnaces, Soaking Pits, Forge Furnaces Reheating and Annealing Furnaces, Cupolas, Boilers

R&I SUPER #3000 Refractory Cement



This coke oven floor was repaired, while still hot, with Super #3000, without expensive labor or having to cool down the oven. Using Super #3000 has saved the coke plant $10,000 in a short time.

✓ Sets Harder
✓ Bonds Stronger
✓ Lasts Longer Under Severe Service at High or Low Temperatures

Super #3000 is a ready mixed, plastic mortar for laying new refractories, patching, or wash-coating refractories for added protection.

Made to withstand any working temperature to 3000° F., flame erosion and abrasion, Super #3000 is matchless for adhesiveness and durability. It does not crack or break, and definitely reduces spalling.

Super #3000 is easy to mix and apply. It air sets quickly to flint-like hardness and makes joints that outlast the refractories it bonds.

Where service is severe, where repairs are frequent, you can reduce your maintenance troubles and expense by bonding or patching with Super #3000.

Use the best. Use Super #3000 Refractory Cement. Write for full details.

REFRACTORY & INSULATION CORP.

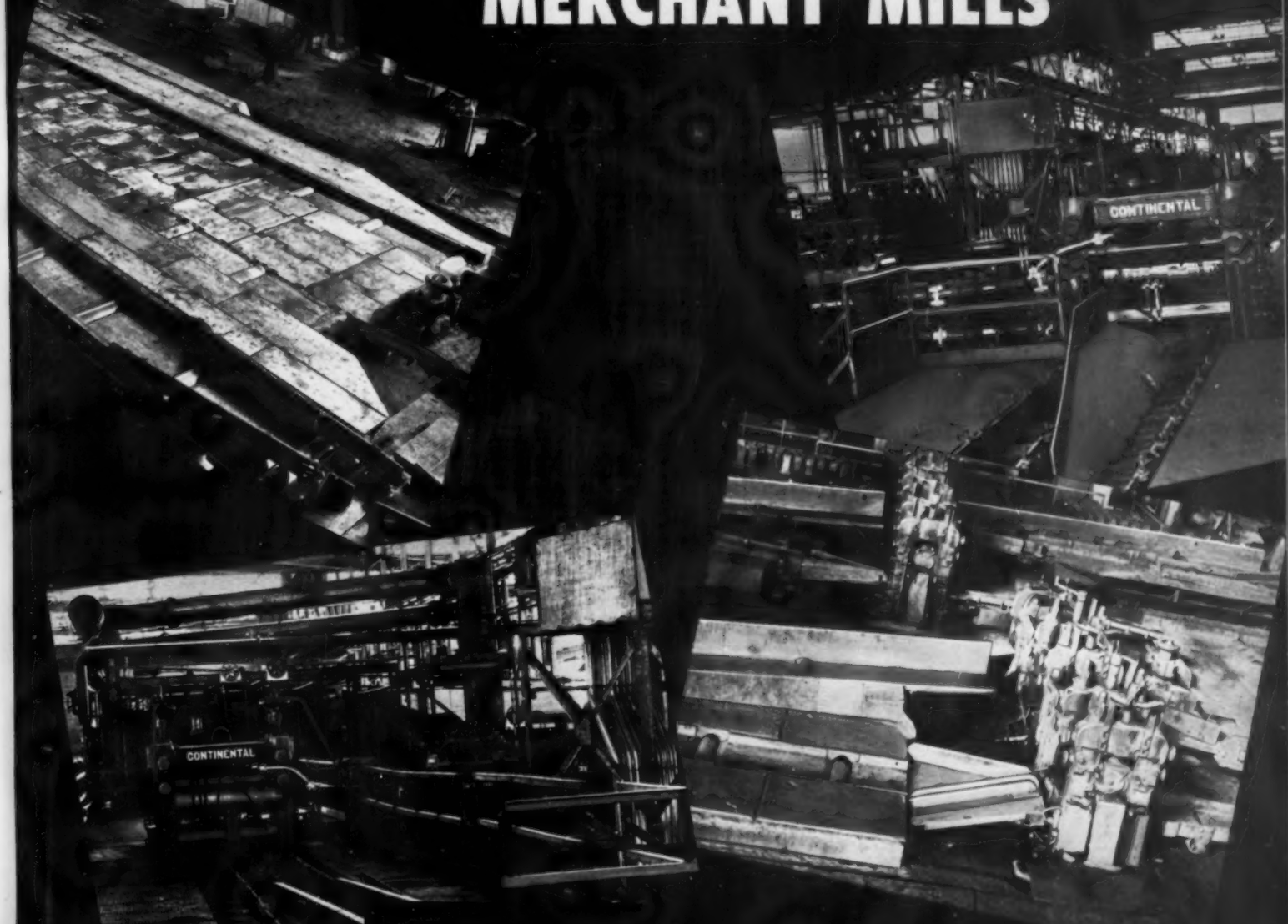
R&I Bonding and Castable Cements • Insulating Block, Blankets and Cements

126 WALL STREET • NEW YORK 5, N. Y.

Offices in Chicago—Philadelphia—Cleveland—Newark, N. J.

take a new look at *Continental*

MERCHANT MILLS



Continental

FOUNDRY & MACHINE CO.

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Plants at: E. Chicago, Ind.; Wheeling, W. Va.; Pittsburgh, Pa.

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Iron and Steel Rolls
Carbon and Alloy Steel Castings

gear drives

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CHICAGO ★ PITTSBURGH

Plants at East Chicago, Ind., Wheeling, W. Va., Pittsburgh, Pa.

CONTINENTAL
Foundry & Machine Company

N-B-M Meadville . . . a plant that's worth seeing! Visits from Blast Furnace Superintendents and other Steel Mill Officials are welcome. When can you make an inspection trip?

why did this slipper ELIMINATE 2 OUT OF 3 REPLACEMENTS?

How an alloy developed by N-B-M Research resulted in 1 slipper with the service life of 3

One of the toughest applications you'll find for testing the mettle of a bronze alloy is Blooming Mill Slippers . . . they take the shock, stresses and frictional wear of the mill driving universals. As an example of the tough service involved, aluminum bronze slippers formerly used in a large Eastern steel company's blooming mill averaged just 3 months' service life before wearing out.

Our engineers suggested a change to N-B-M Alloy 10-B—a Bronze specially developed by National Bearing Research, for this purpose.

Result? **Slippers cast from this N-B-M Alloy averaged 9 months of service instead of 3 . . . eliminated 2 out of 3 replacements! Performance was so far superior that this steel company now standardizes on N-B-M Slippers throughout the mill.**

We're proud of examples like this . . . because they show how effectively our facilities for Research and Engineering—combined with 78 years of practical experience—make money-savings solutions to problems on . . .

- Slippers
- Roll Neck Bearings
- Housing Nuts
- Bronze Bars
- Babbitt Metals
- Tuyeres
- Tuyere Coolers
- Valves
- Valve Seats and Plugs
- Monkeys

AMERICAN Brake Shoe COMPANY

NATIONAL BEARING DIVISION

4936 Manchester Avenue • St. Louis 10, Mo.

PLANTS IN: ST. LOUIS, MO • MEADVILLE, PA. • NILES, OHIO • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

• • • • Every steel man knows this picture. He knows that the open hearth has made possible steel's magnificent contribution to America's industrial growth...our amazingly high standard of living. And he knows that steel production stands as our first line of defense in today's troubled world.

The refractory industry has kept pace with steel by producing refractories that last longer . . . stand higher heats . . . are available in adequate quantities. General Refractories is proud of its part in this task of serving steel.

Inside this furnace you may find

The Inside Story

GENERAL REFRACTORIES

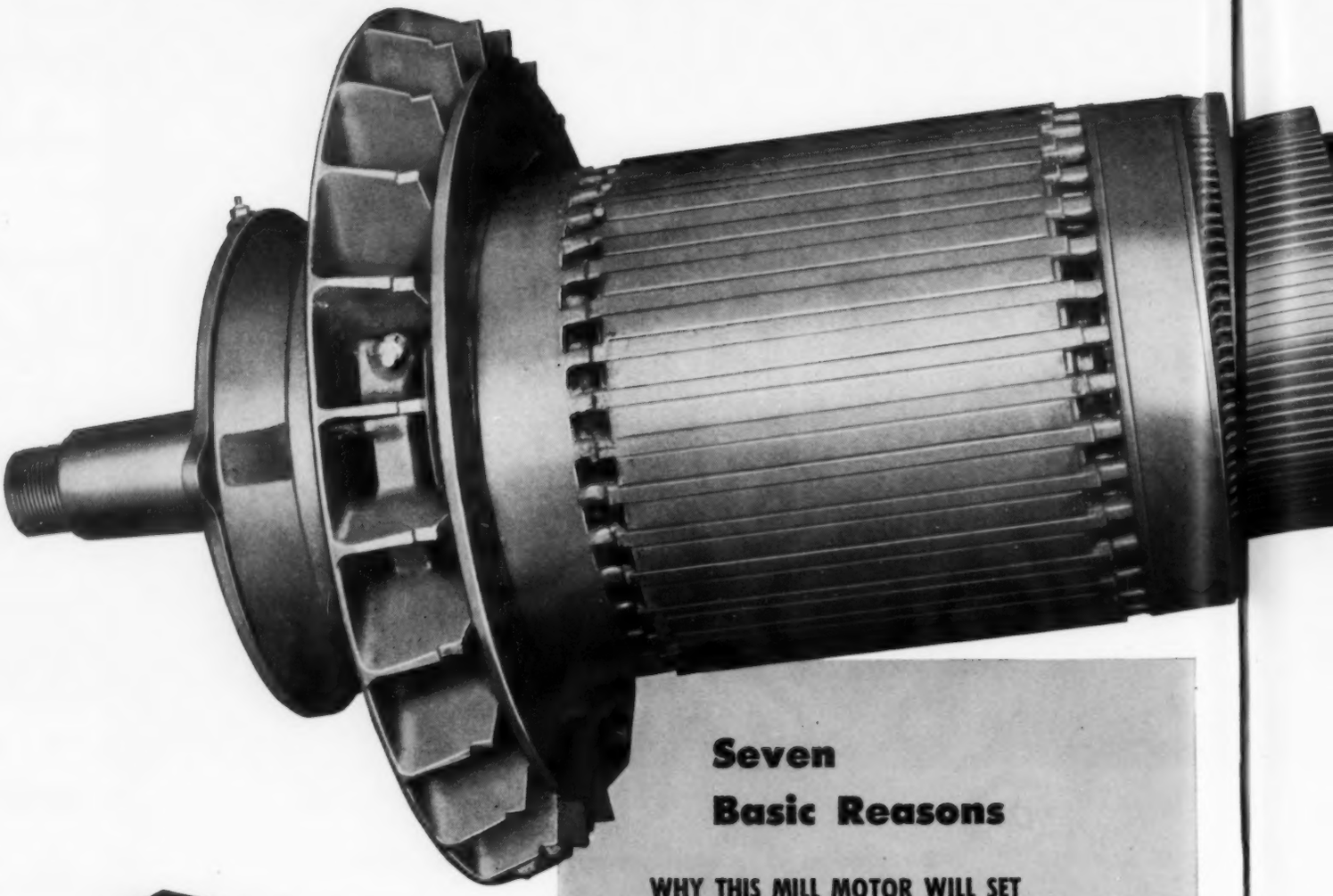
GENERAL REFRACTORIES COMPANY
PHILADELPHIA

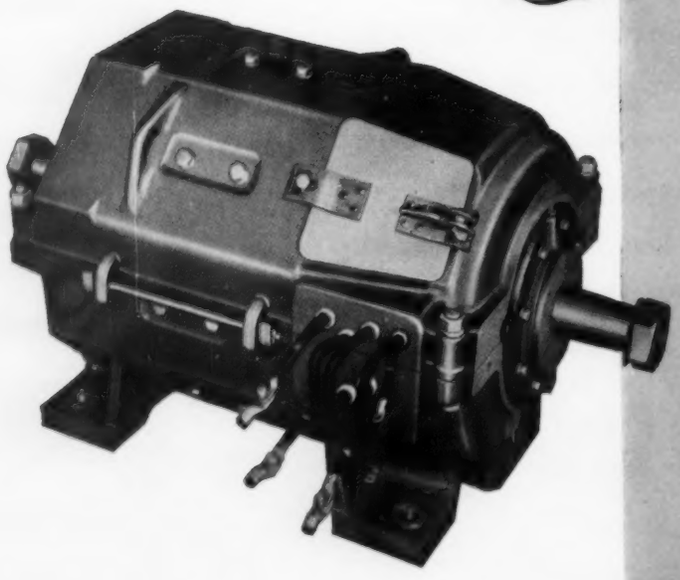
RITEX C and RITEX A Basic brick, STEELKLAD brick, General's Silica and Fireclay brick. But throughout the plant you'll find many another General product scientifically designed and produced to do the particular job at hand.

General offers the steel industry exhaustive research facilities, modern production methods, skilled personnel. General's 43 mines, 29 plants, 18 sales offices and more than 200 distributing agencies are strategically located throughout the nation and abroad. In short, General offers you a complete refractories service!

A Complete Refractories Service

●





Seven Basic Reasons

WHY THIS MILL MOTOR WILL SET NEW STANDARDS OF PERFORMANCE IN YOUR PLANT

1. BETTER COMMUTATION: Brushes with ample current-carrying capacity—properly designed commutator—specially shaped commutating pole faces.

2. UNIT ASSEMBLY OF FIELD COILS: Formed coil completely insulated and then assembled on a steel shell to protect coil from grounding or chafing against the pole.

3. HIGHER MAXIMUM SAFE SPEEDS: Anchoring of armature coils with individual wedges permits safe operation at higher speeds—no core bands to come loose and cause trouble.

4. HEAVIER AXLE STEEL SHAFT: Larger in diameter between the bearings, on horsepower basis—made possible by mounting punchings directly on the shaft which is removable.

5. RIGIDLY MOUNTED COMMUTATOR: Bridge construction supports each end of commutator on shaft—no overhang.

6. CAST-ALUMINUM FAN: One piece—large diameter provides a plus in cooling.

7. LOW-INERTIA ARMATURE: Allows motor to start, stop and reverse with minimum stored energy.

Look — No Core Bands!

Wedges give you the toughest mill motor built

Wedges, instead of bands, hold the armature coils firmly in place on the new Westinghouse Series 600 Mill Motor. This means a stronger armature that is capable of safe operation at higher speeds . . . increased motor efficiency.

Broken core bands are destructive, also core bands can cause damage to the insulation on armature coils during assembly. Wedges eliminate this risk—make winding a simple operation. Each slot has its own individual wedge . . . made of Class B material. Simplifies servicing and repair work.

Further, complete insulation of the armature provides maximum electrical strength. Mica wrapper and glass tape protect the conductor. Complete armature assembly is impregnated with thermoset varnish. All this adds up to a rugged armature for a strong motor—built to handle your toughest jobs.

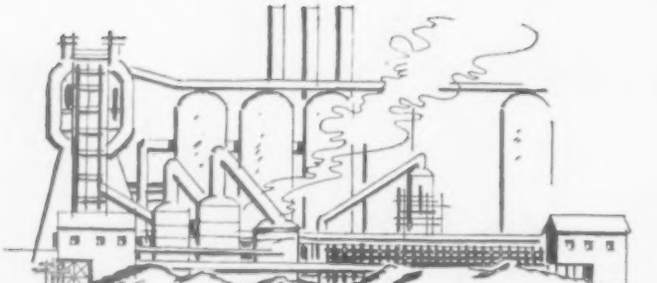
There are many more advantages offered by this mill motor that you will want to consider. Your Westinghouse representative has all the facts. Ask him for your copy of Booklet B-4730. Or write direct to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21646

YOU CAN BE SURE.. IF IT'S

Westinghouse

MILL MOTORS AND CONTROLS

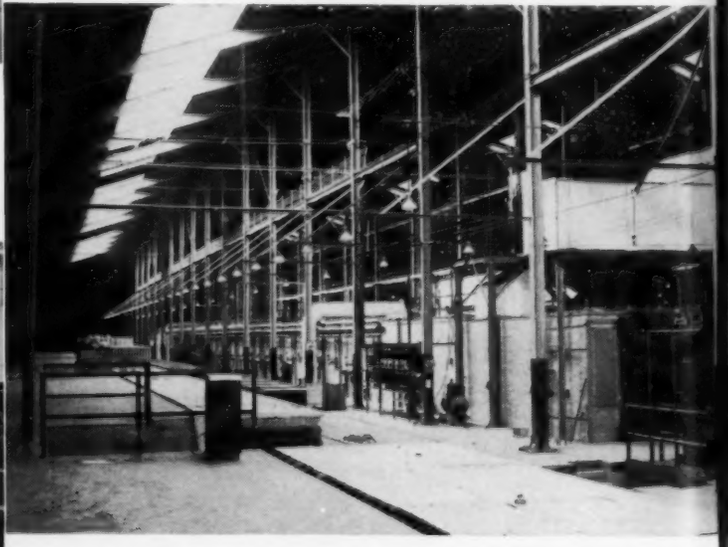
HARBISON-WALKER *Blast*



Blast furnace brick of the right quality for each zone are necessary for maximum production and greatest economy. The full complement of Harbison-Walker Blast Furnace Refractories provides for the proper selection for every combination of furnace operating conditions.

For more than half a century Harbison-Walker Blast Furnace Refractories have been the leading choice of the industry. Recent surveys disclose the fact that the major portion of linings currently installed in the United States, Canada, and Mexico are Harbison-Walker brands. At present, complete and partial Harbison-Walker linings for more than 100 blast furnaces and stoves are in process of manufacture. Whether your furnace practice calls for the best standard conventional linings or for super-duty linings, Harbison-Walker produces the refractories best suited for your specific needs.

Extensive Research is an extremely important fundamental in the development of Harbison-Walker Blast Furnace Refractories.



One of the modern tunnel kilns used in the production of blast furnace brick. Accurate control of firing conditions is a major factor in securing the most desirable physical properties.

Vacuum power pressing with the most modern equipment contributes to the dependable high quality and excellent workmanship of Harbison-Walker blast furnace refractories.

Furnace REFRACTORIES

for SERVICE-BALANCED *linings*

Regular or Special Zoned

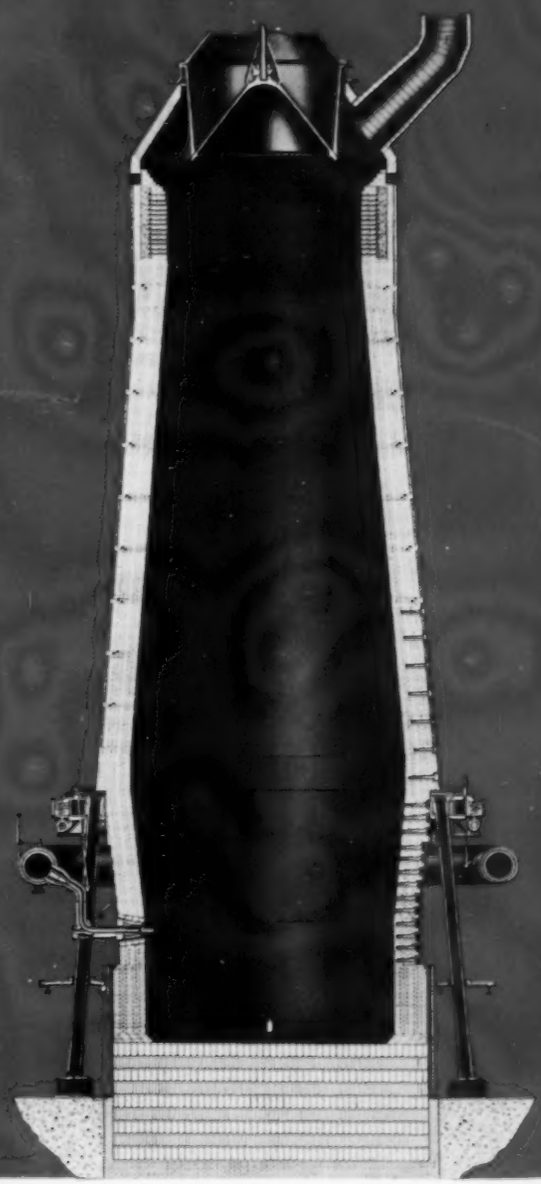
Harbison-Walker widely used brands have the essential physical and chemical properties for well-balanced blast furnace linings, best suited for every size and design of furnace.

VARNON B F

—extremely hard-fired, super-duty fireclay brick, having the most complete development of the properties of high strength and density, low porosity and permeability, immunity to disintegration by carbon monoxide, a wide margin of safety in refractoriness and high resistance to spalling and slagging.

H-W 18

—hard-burned, high duty fireclay brick, fired under accurately controlled special conditions which enhance the physical properties. These brick are exceptionally resistant to abrasion, and to disintegration by carbon monoxide. H-W 18 brick are low in permeability and porosity, have high mechanical strength and excellent volume stability at working temperatures.



BENEZET B F and H-W Ky. B F

—for many years the tried and proved standard refractories for most blast furnaces—for hearth and bosh, inwall and top linings.

Harbison-Walker's research program has continued to improve these standard quality products as well as to lead in the development of the super-duty classes.

BONDING MORTARS

—Harbison-Walker produces bonding mortars especially adapted for use with every kind and class of blast furnace brick. The best results are secured with the proper selection of these mortars according to the type of brick and service requirement.

TECHNICAL SERVICE

Harbison-Walker Engineers welcome the opportunity to assist in the selection of the brands that will provide the lining for the best over-all performance in your individual furnaces—balanced with respect to operating conditions and economy.

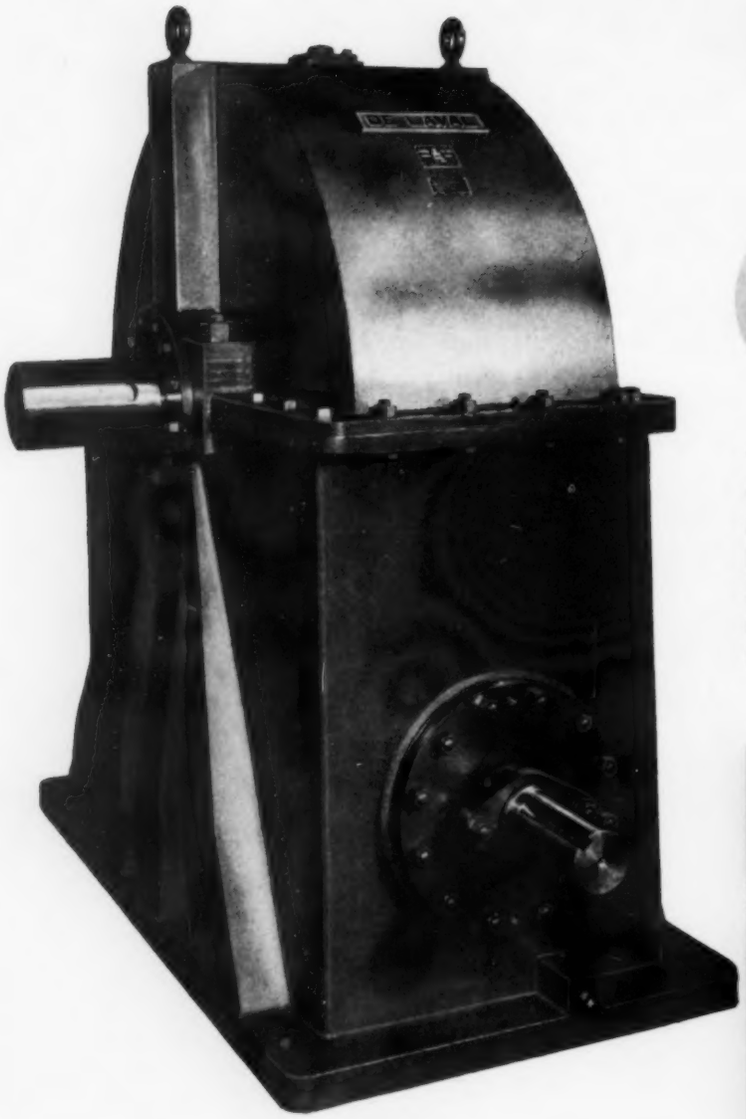
HARBISON-WALKER REFRACTORIES COMPANY

AND SUBSIDIARIES

World's Largest Producer of Refractories

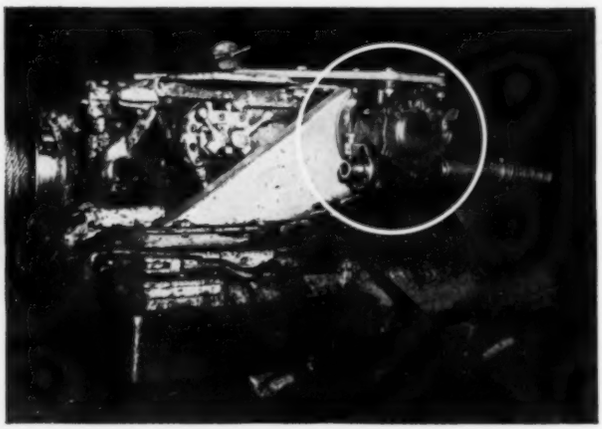
***General Offices:* PITTSBURGH 22, PENNA.**

We build'em all sizes at De Laval



Giant

Take a look at this 30″ center distance worm gear speed reducer! As far as we know, it is the *largest* standard enclosed drive unit ever built. It's doing a big job, too, on a large Mesta Machine Co. slabbing mill for a prominent steel company. A twin of this giant is scheduled for a new eastern mill.



FREE

Easy-Selection Manual

Is there a quick way to select the right reducer for your application? Yes, new De Laval Manual G-WBV makes it simple as ABC. It contains complete selection data, hp rating tables and outline drawings . . . all set up in easy-to-use form. Write for your copy today.

Dwarf

Here's one of the smaller De Laval worm gear speed reducers with a 3″ center distance. It is being used by the Crichton Company, Johnstown, Pa. for their new coal drilling machine. Big, small or in-between, De Laval heavy duty worm gear reducers are proving profitable investments for scores of machinery manufacturers throughout the country.

50th Anniversary

DE LAVAL *Speed Reducers* ***Built to be Built-into a Quality Product***

DE LAVAL STEAM TURBINE COMPANY • TRENTON 2, NEW JERSEY

DL-105

better measurement and control of

PRESSURE

From vacuum to 80,000 psi . . .

Whether the critical pressure of your process is full vacuum, 80,000 psi, or any range between . . . the complete diversity and engineering quality of Foxboro Instruments provide a means to measure or control it with highest accuracy and reliability. Add to this an unequaled experience in applying instruments to solve processing problems, and you have the reason for Industry's preference for Foxboro Pressure Instrumentation.

INDICATORS · RECORDERS · CONTROLLERS
TRANSMISSION SYSTEMS · CONTROLLED VALVES

FOXBORO
Reg. U. S. Pat. Off.

For over 40 years, specialists in the measurement and control of temperature, pressure, flow, liquid level, humidity . . .

THE FOXBORO COMPANY · FOXBORO, MASSACHUSETTS, U.S.A.

FOR LESS SERVICING...
AND MORE SERVICE...
AROUND THE CLOCK...
YEAR-AFTER-YEAR...

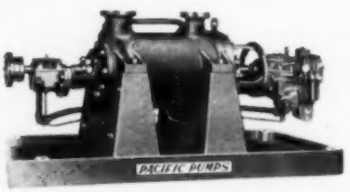
SPECIFY

Pacific

Precision Built CENTRIFUGAL BOILER FEED

PUMPS

PACIFIC TYPE WBF

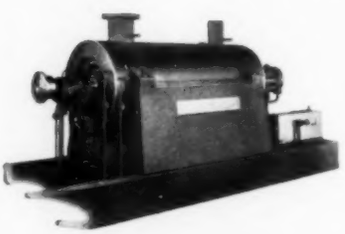


PACIFIC TYPE ABF

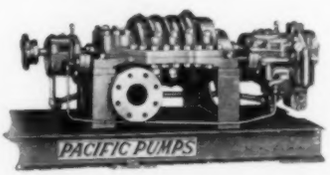
You Specify – The capacity, temperature and pressure.

Pacific Will Specify – The most efficient size and the correct materials.

You Will Receive from Pacific – A custom built pump with pressure castings, hydrostatic tested . . . each part precision finished and inspected . . . one-piece impellers, dynamically balanced . . . performance tested and shipped with parts protected with rust inhibitor. *Write for Bulletin Number 109.*



PACIFIC TYPE IBF



PACIFIC TYPE JBF

Pacific Pumps inc.
ONE OF THE DRESSER INDUSTRIES

HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York • *Offices in All Principal Cities*

BF-13

Sheet Mills
of about
50 Years Ago

United 6 Stand, 4-High Tandem Hot Mill

50 YEARS AGO

The Old Grey Mare Was Queen of the Highways

DEVELOPMENT of mass production methods in the manufacture of automobiles brought a new era of progress to America. Paved road construction paced new car production . . . farmers were rescued from isolation . . . remote and inaccessible areas were opened for development . . . new industries were born, commerce increased, living standards raised to new, high levels.

Without steel, and the machinery for rolling and forming it, mass production of the automobile and the progress attending it, would have scarcely been possible.

For what United has been able to contribute to better steel rolling processes, we are deeply grateful. It is our hope that we may continue to serve the industry as well in the years to come as we have so earnestly tried to serve it in the past.

Golden Anniversary
1901 UE&FCO 1951

UNITED

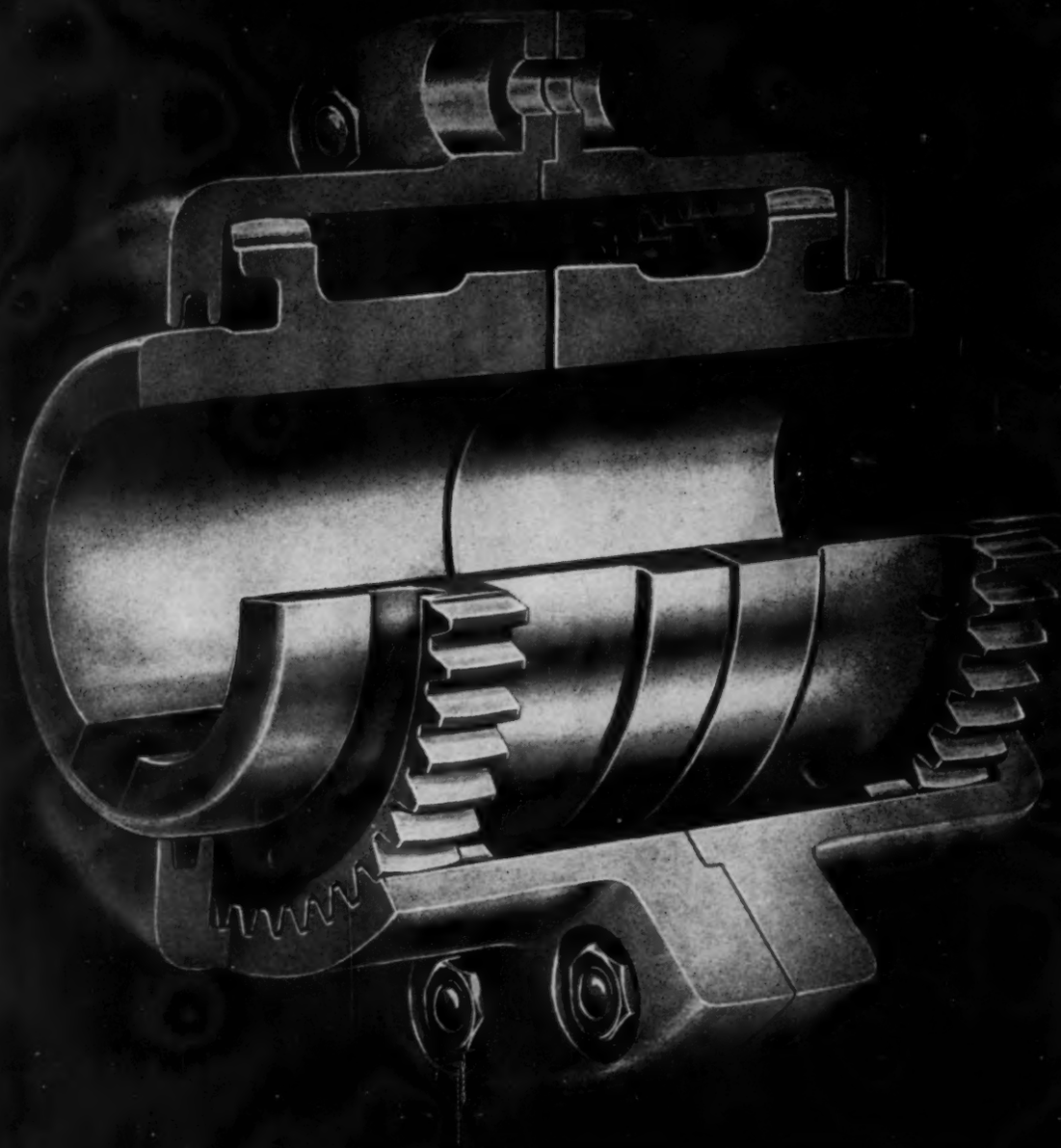
ENGINEERING AND FOUNDRY COMPANY

Pittsburgh 22, Pennsylvania

Plants at PITTSBURGH • VANDERGRIFT • NEW CASTLE • YOUNGSTOWN • CANTON

Subsidiaries: ADAMSON UNITED COMPANY, AKRON, OHIO • LOBDELL UNITED COMPANY, WILMINGTON, DELAWARE • STEDMAN FOUNDRY AND MACHINE CO., INC., AURORA, INDIANA

POOLE



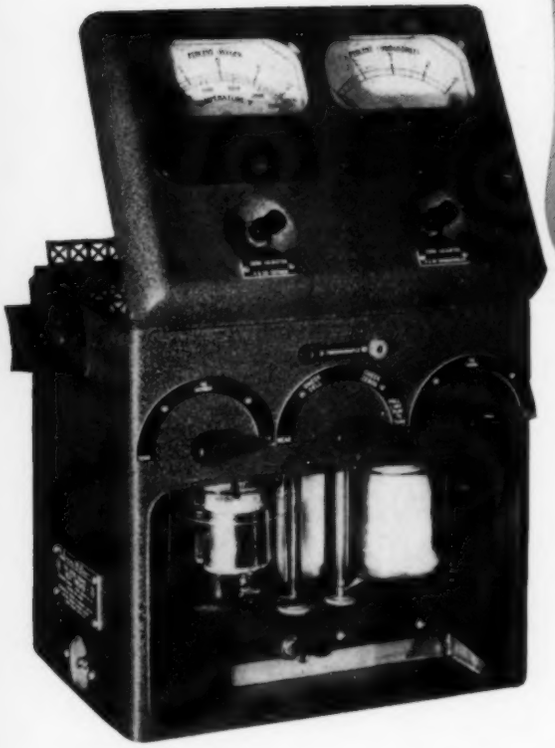
A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

I SPY



Not an instrument you *buy*,
but a service we *supply*.
Write or call us today.

THE COMPLETE CITIES SERVICE LINE FOR THE METAL FABRICATING INDUSTRY INCLUDES

- Chillo Cutting Oils
- Trojan Greases
- Trojan Gear Oils
- Pacemaker T Hydraulic Oils
- Optimus Cylinder Oils
- Q-T (Quenching and Tempering) Oils

Combustion Facts Fully Revealed by Fast, Simple Heat Prover Test

This scientific combustion analyzer—the Cities Service Heat Prover—gives you the real "inside" on furnace combustion conditions. Its plain, quick, accurate work lets you know:

How much excess oxygen is present

How much combustible matter is wasted

How much fuel you might save

Without endless trial-and-error you can proceed to conserve fuel and increase furnace output. This is substantiated by records made on all types of furnaces. See for yourself how productivity can be improved. Call or write *today* for a Cities Service Heat Prover demonstration... readily arranged in your plant. Or for further details return the coupon below.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

CITIES SERVICE OIL COMPANY
Sixty Wall Tower, Room 206
New York 5, N. Y.

Without obligation please send your booklet, "Combustion Control for Industry" and Heat Prover information.

Name_____

Company_____

Address_____

City and State_____

LEWIS ROLLS

OVER 90 YEARS OF ROLL MAKING

LEWIS

Star in the performance of Rolling a better product

"X" AND "XA"
SUPERIOR "X"
AJAX DUPLEX
SPECIAL PROCESS
MOLYBDENUM CHILLED IRON
PLAIN CHILLED IRON
CLIMAX AND AJAX
ATLAS AND ATLAS "B"
SPECIAL TUBE MILL ROLL

THE MARK OF A PERFECT ROLL BUILT TO FIT YOUR NEEDS

LEWIS FOUNDRY & MACHINE
DIVISION OF BLAW-KNOX CO.
PITTSBURGH, PENNA.

MANUFACTURERS OF
ROLLS AND ROLLING MILL EQUIPMENT
FOR THE IRON, STEEL AND
NON-FERROUS
INDUSTRIES

which of these feed-in duct features *rate highest with you?*

architects

rate these SQUARE D features particularly high:

lowest known voltage drop . . . maximum efficiency, minimum power loss

smallest cross-sectional area . . . conserves valuable installation space

contractors

give these features top billing:

reduced installation time . . . simplified components, factory prefabrication

new joint design *(lower right)* . . . all joint ends identical, connection bolts face outward

interchangeable standard fittings . . . permit horizontal or vertical riser applications

users

vote these SQUARE D features tops:

low cost installation and maintenance . . . most accessible connections

totally enclosed . . . permanent safety construction, excludes dust

completely reuseable . . . rearrangement with the same components

EXCLUSIVE JOINT DESIGN

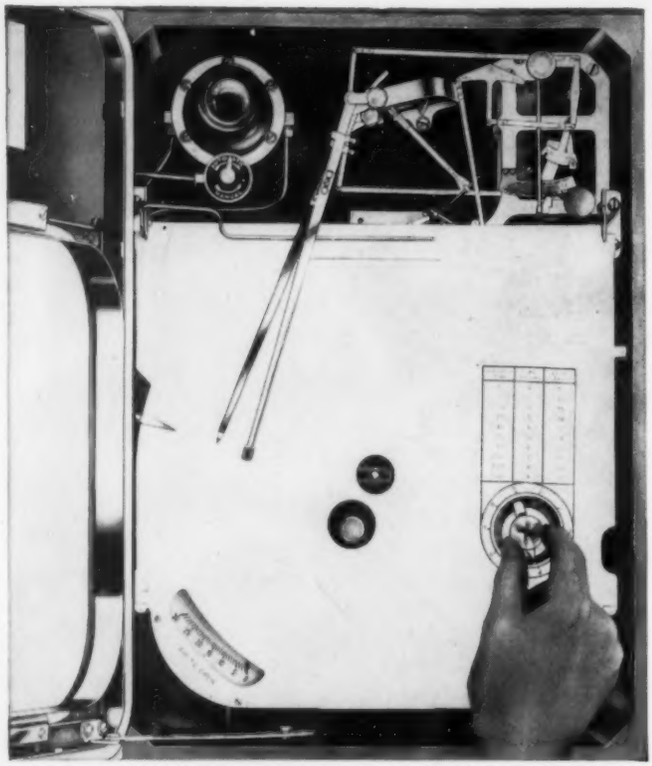
SQUARE D's exclusive joint design saves installation time and reduces maintenance cost. Joint ends are identical—unnecessary to select mating ends before positioning or hanging duct sections. Outward-facing, pre-installed bolts permit rapid assembly and easy maintenance.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

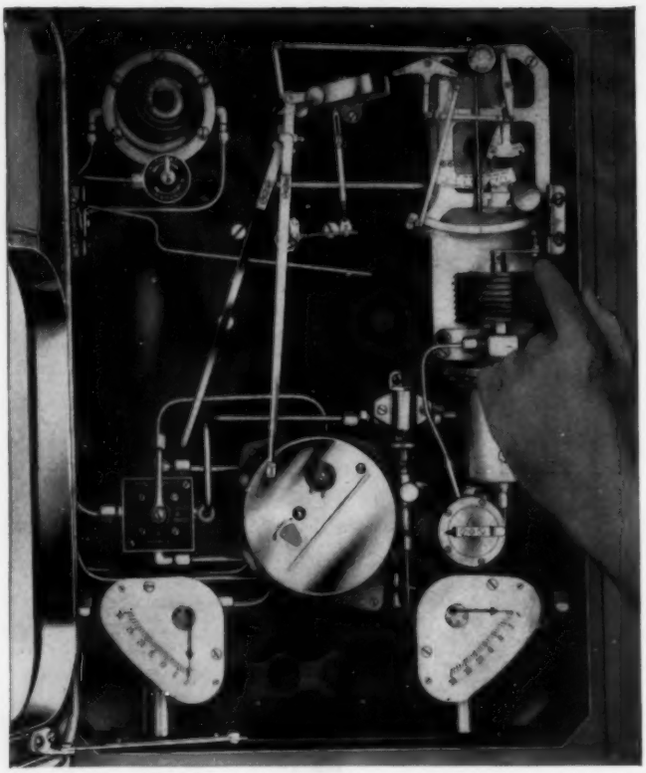
SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.



EASIEST TO PUT INTO OPERATION—Calibrated control actions save hours of shutdown. Reset, derivative and proportional values can be exactly reproduced at any time on the same or any other Series 500 controller . . . merely by duplicating the setting. Thus: controller adjustments can be standardized for any process throughout a plant or national organization.



EASIEST TO SERVICE—Inherently simple design, using the fewest possible parts, plus extremely close-tolerance manufacturing . . . make the instrument thoroughly interchangeable, trouble-free and a cinch to service. For example: only one simple adjustment puts the system in exact calibration even after complete disassembly and reassembly.

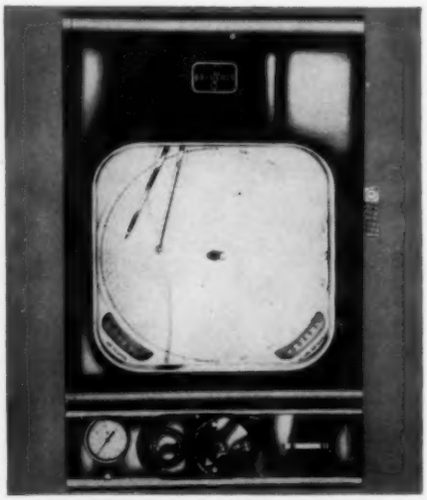
ONLY BRISTOL SERIES 500 CONTROLLERS GIVE YOU THIS EASE OF OPERATION

When you wish to reproduce a previous control action or duplicate one taking place at some other point, the Bristol Series 500 Air-Operated Controller permits you to do it merely by setting a dial.

Or, should the instrument require servicing, only one simple adjustment is needed to calibrate the control system and put it back in operation. Almost anyone can service this instrument.

Furthermore, users report that the Bristol Series 500 Controller requires practically no maintenance.

This outstanding instrument—a product of 60 years of experience—is completely described in Bulletin A120. THE BRISTOL COMPANY, 123 Bristol Road, Waterbury 20, Conn.



BRISTOL SERIES 500 CONTROLLERS are offered in five types—on-off, proportional, reset, derivative, reset plus derivative—to control temperature, flow, pressure, liquid level, humidity, pH. Conversion from one type to another can be made by the user. Model shown has external-manual station with mechanical interlock for test and service

BRISTOL

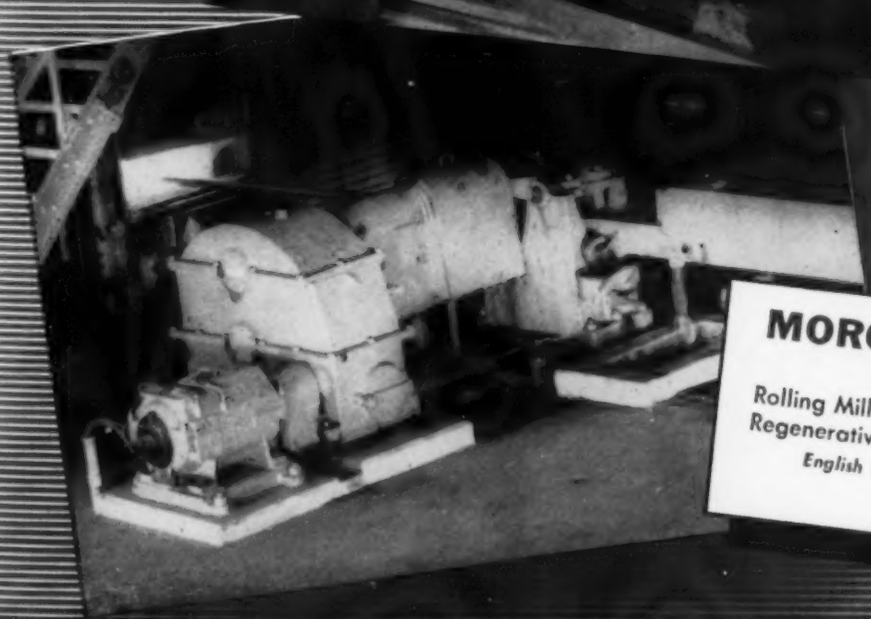
AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

How's this for a "HOT ROD?"

This new Morgan development pushes billets out of their hellhole with remarkable efficiency and makes an easier and more comfortable job for the operator.

The pushout bar is water-cooled and reciprocated by a pair of power driven pinch rollers. Lateral motion of the unit is made hydraulically, enabling the operator . . . with finger-tip control . . . to align the pushout bar accurately with the next billet to be discharged.

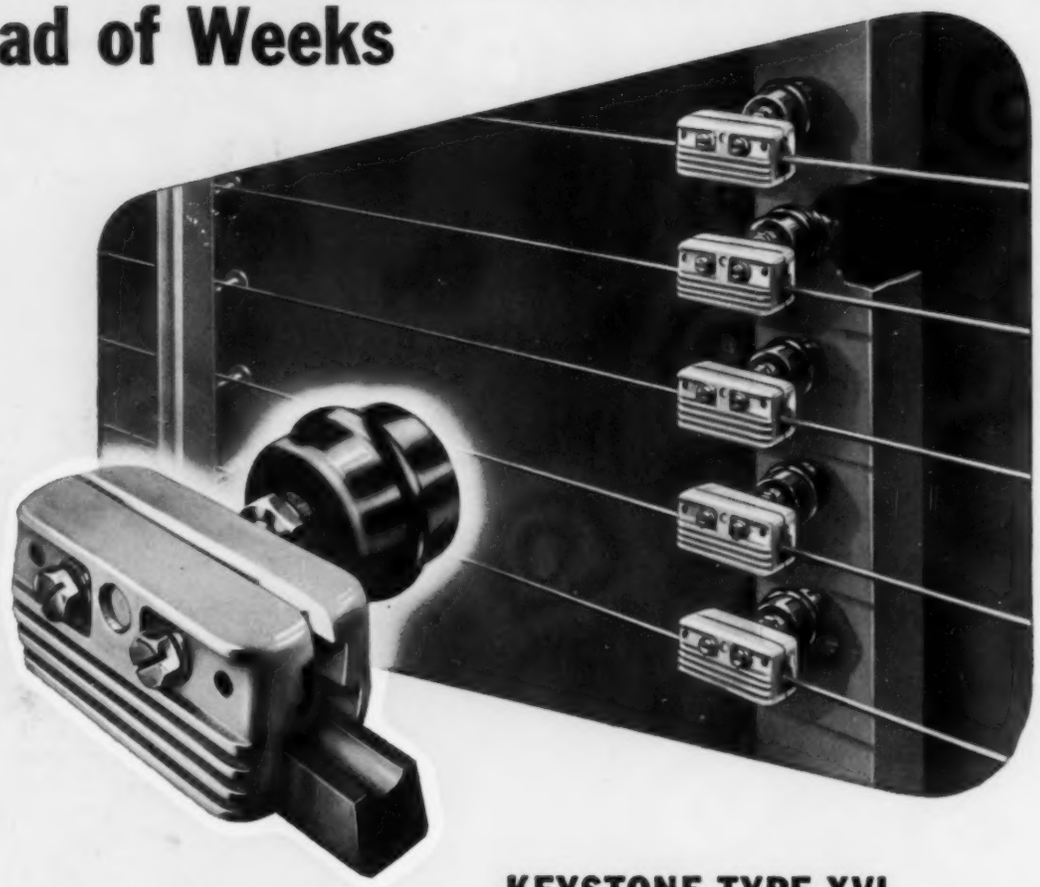
Future advertisements will feature other pioneering developments that keep Morgan mills in the forefront as high producers of quality products. But, why not write today and let us tell you about them?



MORGAN CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS
Rolling Mills - Morgoil Bearings - Wire Mills
Regenerative Furnace Control - Gas Producers - Air Ejectors
English Representative: International Construction Company
56 Kingsway, London, W.C. 2, England

RM-40

NOW Crane Collectors Last *MONTHS*... Instead of Weeks



KEYSTONE TYPE XVI

COLLECTORS CUT DOWN TIME, WORK STOPPAGE, AND COSTS

A large New Jersey corporation had a serious current collector replacement problem on its foundry crane. Ordinary collectors failed after one week's service! Production stopped, but furnaces still burned, as workers climbed up to make replacements.

Loss in production and labor time prompted the company to find a better current collector. Keystone Type XVI Collectors were recommended and installed. Now collectors *last months* before replacement is required! Production is up with a minimum loss of labor time.

Some Keystone Type XVI Collectors have lasted 25 times longer than ordinary collectors. Features include, inexpensive carbon contact easily removed by backing out two set screws. Large contact area is non-arcing, noiseless, self-cleaning and self-lubricating. Provides constant contact, longer life. Housing consists of two aluminum castings with large radiating fins to provide lower operating temperatures. For all sizes of trolley wires up to 4/0 incl.

If you have a similar current collecting problem in your plant, find out about Keystone Type XVI Collectors. Write us today for latest, illustrated folder on Keystone electrical products.

ELECTRIC SERVICE MANUFACTURING CO.

PHILADELPHIA 32, PENNA.

Manufacturers of complete line of insulator supports for rail and wire conductors and current collection devices.

ANOTHER QUALITY FEATURE IN...

ELLIOTT

FABRI-STEEL

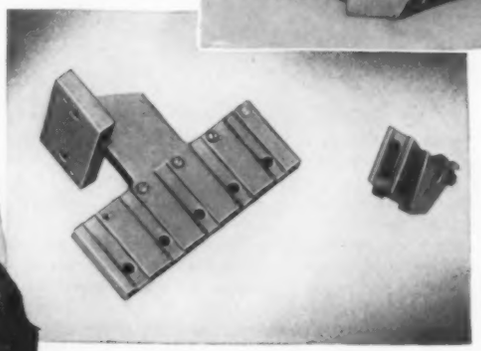
D-C MOTORS

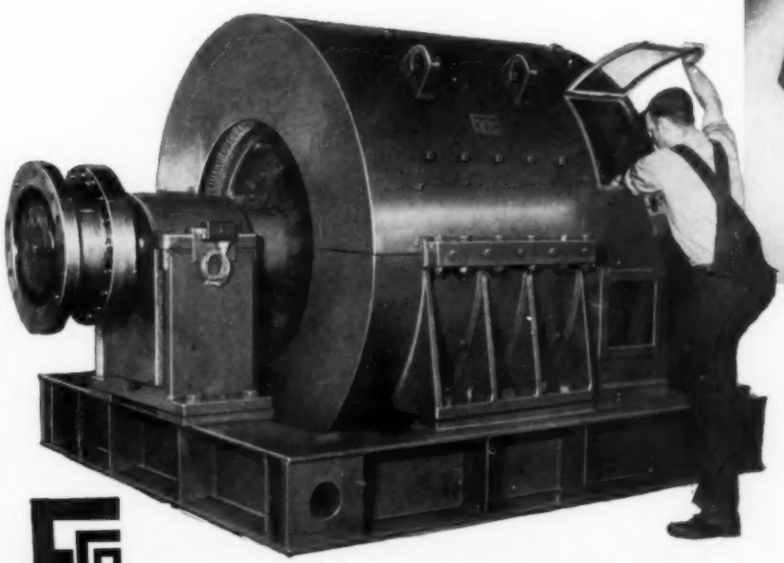
An exceptionally dependable, accurate and simple

brush rigging

The brush yoke in Elliott DC Motors fits into frame supports bored concentric with the bore of the frame, assuring concentricity of yoke with frame and commutator. The brushholder bracket, machined to close tolerance, is fitted to the brush yoke, positioned with a special fixture for spacing and angle, then bolted and doweled to the brush yoke. Canvas phenolic plates, tubing and dowels provide insulation between bracket and yoke.

Each brushholder fits in a machined groove in the bracket. When the commutator wears, the loosening of one bolt in each brushholder permits it to be slid down its groove for correct clearance without affecting its original spacing or angular setting. Just one more of the numerous features that throughout the steel industry are making "Elliott Fabri-Steel" synonymous with forward-thinking motor and generator development.





Removable, hinged, quick-opening doors, of clear plastic, to get at commutator and brushes.

For full details on Elliott Fabri-Steel DC Motors, write to:

MR-5

ELLIOTT COMPANY DEPT. I-S, RIDGWAY DIVISION RIDGWAY, PA.

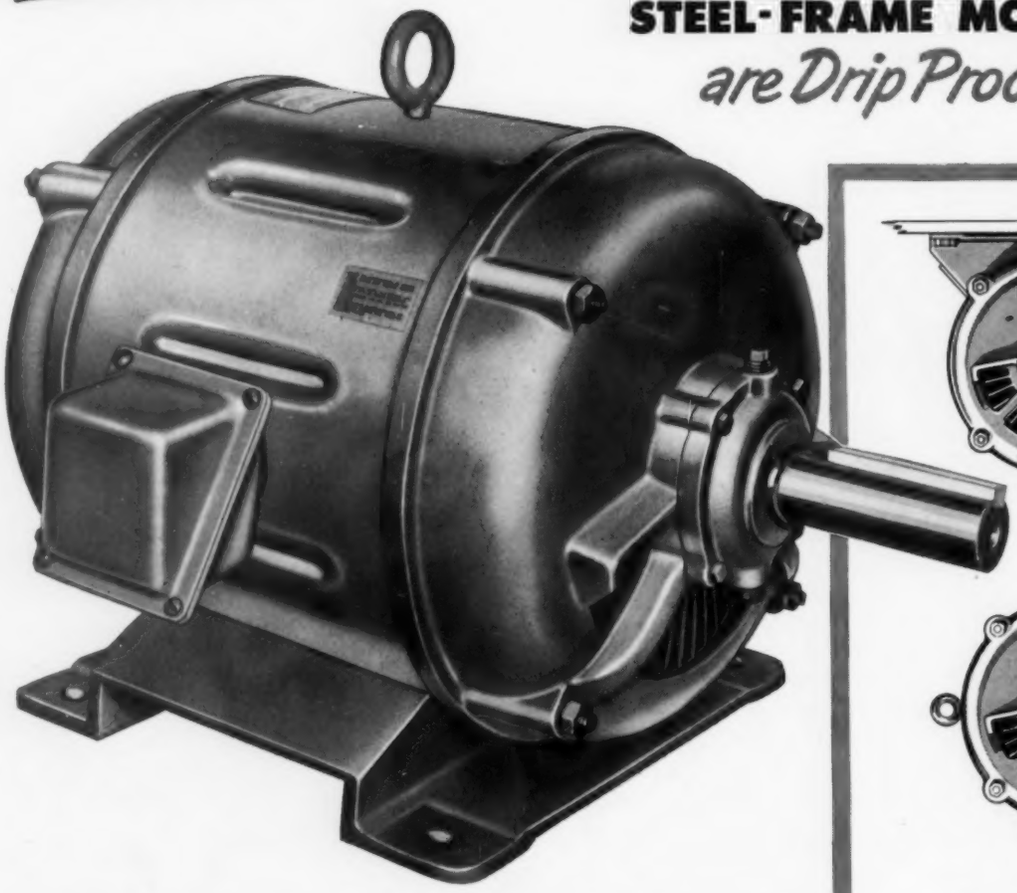
Plants in JEANNETTE, PA., RIDGWAY, PA., AMPERE, N. J., SPRINGFIELD, OHIO, NEWARK, N. J.

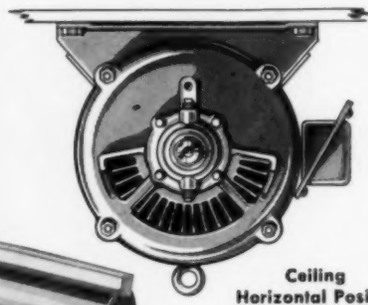
DISTANCE CALLS TO ALL PRINCIPAL CITIES

Wagner
ELECTRIC MOTORS
... the choice of leaders in industry

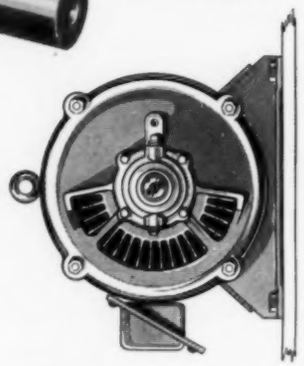
Ceiling Mounted-Sidewall Mounted
or in normal horizontal position

Wagner
STEEL-FRAME MOTORS
are Drip Proof

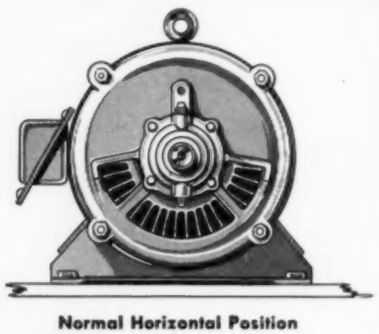




Ceiling
Horizontal Position



Sidewall Horizontal Position



Normal Horizontal Position

and... they're *proved* by years of service.

Here's an open-type general purpose motor that's completely drip-proof in any horizontal position, in frames 326 and smaller, because there are no openings in the frame and the endplates can be rotated 90° or 180° for drip-proof installation on walls or ceiling.

These steel-frame, squirrel-cage motors have been *proved*—for long, useful, troublefree life by more than twenty years of hard usage in many industries. Wagner steel-frame motors are available with either sleeve or *ball bearings which may be relubricated.* The motor frames are formed of heavy rolled steel, shaped to accurately center the stator core and to provide passages for ample ventilation. An internal fan moves a large volume of cooling air through these passages to carry off heat from all parts of the motor.

Wagner Steel-Frame Motors are available in electrical types to meet most industrial requirements.

Bulletins give full information on the complete line of Wagner Motors. Thirty-one branches, located in principal cities, are ready to assist you whenever you have a motor problem. In addition, almost 650 authorized motor repair shops provide speedy, nationwide service facilities.

Wagner
Electric Corporation
1891 WE 1951

WAGNER ELECTRIC CORPORATION
6483 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 31 PRINCIPAL CITIES

M51-18

Alliance

FIRST IN SIZE
FIRST IN CRANE DESIGN

● We produce big and unusual cranes. We're delighted with unheard of and almost impossible applications for cranes. For example, above is a 270-ton gantry crane installed fifteen years ago on this dam. Successful operation of the dam depends on the crane. Similarly, other huge installations depend on **big Alliance cranes.**

On this crane two 135-ton trolleys can act independently or in combination when lifting loads in excess of 135 tons. One trolley is equipped with a 20-ton auxiliary hoist to handle lighter loads.

For fifty years, Alliance has been designing, engineering and building giant cranes for heavy industry. Where unusual types of cranes are required—for any service—Alliance engineering experience and diversified background of its personnel is generally sought.

Thousands of Alliance cranes are on the job today hoisting and shifting gigantic loads . . . safely, smoothly, quickly, economically. Always rely on Alliance to give your plant dependable extra lifting power.

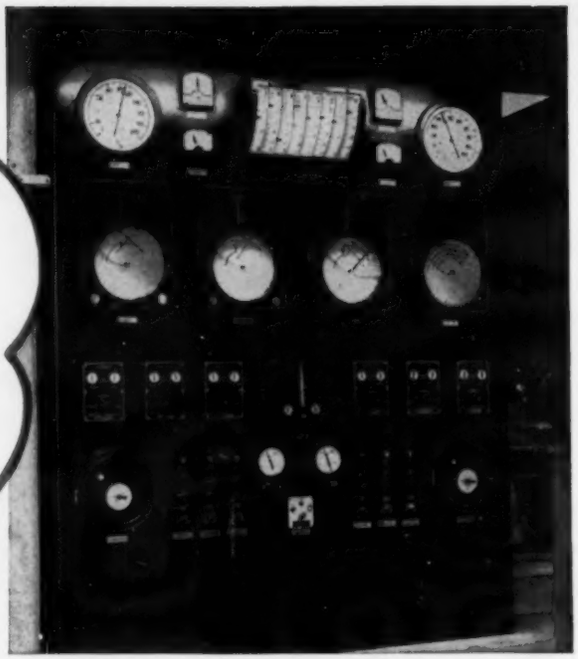
BIG
CRANES

THE ALLIANCE MACHINE COMPANY

MAIN OFFICE
ALLIANCE, OHIO • PITTSBURGH OFFICE **1622 OLIVER BUILDING, PITTSBURGH, PA.**

LADLE CRANES • GANTRY CRANES • FORGING MANIPULATORS • SOAKING PIT CRANES • STRIPPER CRANES • SLAB AND BILLET CHARGING MACHINES • OPEN HEARTH CHARGING MACHINES • SPECIAL MILL MACHINERY • SPECIAL WORK

TIPS ON HOW TO SELECT BOILER CONTROL



Bailey Boiler Control Panel for a 300,000 lb. per hour pulverized coal fired boiler. Both combustion and three-element feed water controls are based on accurate measurements made by meters located on this control panel.

1 Profit From the Experience of Others

It is likely that plants of the type you are considering are being already operated at optimum performance by Bailey Boiler Control. When you select Bailey Controls, you profit from this experience and get the benefit of the latest refinements in application. Over 8,000 boiler units have been equipped with Bailey Controls during the past 10 years. These units range from 3,000 to 1,000,000 lb. per hour capacity and operate at pressures from 75 to 2500 psi. They are fired by pulverized coal, stokers, oil, gas, mixed fuels and waste fuels.

2 Call In Qualified Engineers

Bailey Engineers are qualified by training and experience to consult with you on both the theoretical and practical aspects of your boiler control problems. These specialists in combustion, measurement, and automatic controls are conveniently located in over 30 industrial areas throughout the United States and Canada. Your local Bailey Engineer stands ready and willing to apply the Company's know-how to your plant.

3 Specify a Dependable System

Records indicate that compressed air is a reliable operating medium. Unlike electricity or oil, it continues effective for a time after power failure.

Bailey Boiler Controls are sturdy air-operated units which function in accordance with accurate measurements made by Bailey Meters.

4 Avoid Make-Shift Applications

The wide selection of both measuring and controlling elements offered by Bailey Meter Company provides complete flexibility of control application. The correct combination of these elements does a thorough job without excessive equipment.

5 Insure Smooth Operation

Coordination of related control systems such as combustion, feed water, steam temperature, and condensate flow insures against costly disturbances in plant operation. Proper coordination improves control action, increases safety of operation, reduces auxiliary power required and reduces storage capacity needed in heaters and boiler drums.

6 Be Sure You Can Get Service

Users of Bailey Control have but to call on the nearest branch office of Bailey Meter Company to secure the services of a trained engineer.

For Your Plant

If you want details write for a copy of Bulletin 15-D, or ask a Bailey Engineer to call.

BAILEY METER COMPANY

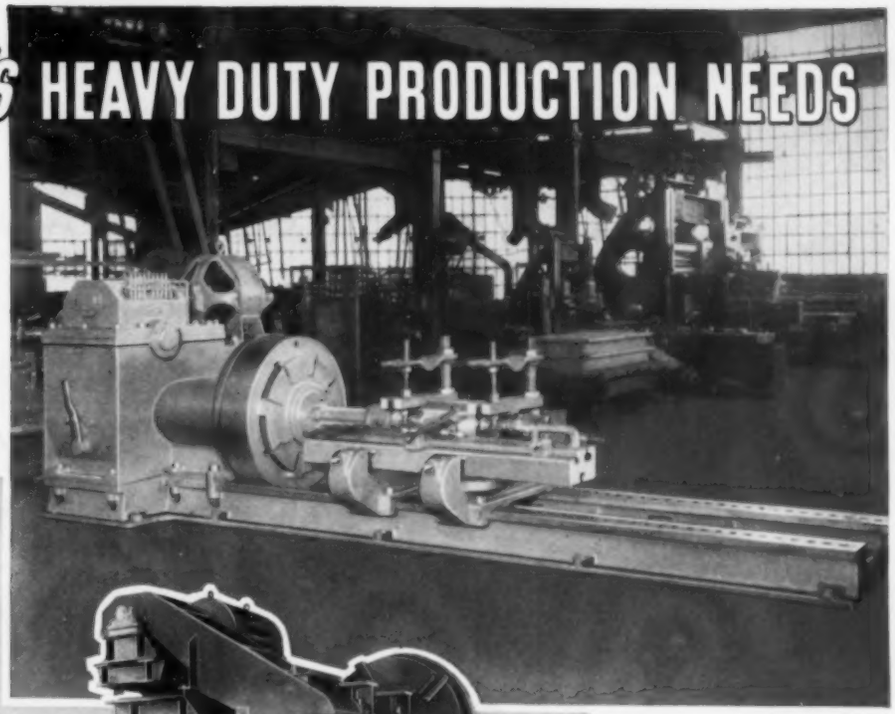
1025 IVANHOE ROAD • • • CLEVELAND 10, OHIO

Controls for Steam Plants

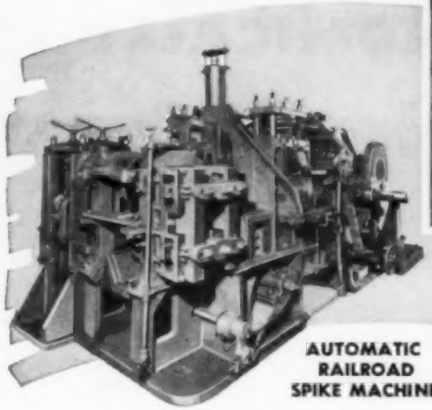
COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

..77-1

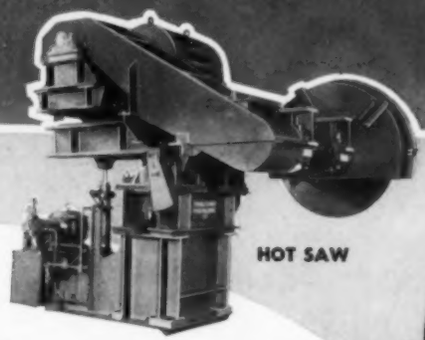
SERVING *TODAY'S* HEAVY DUTY PRODUCTION NEEDS



18" WORM DRIVE ROLL LATHE



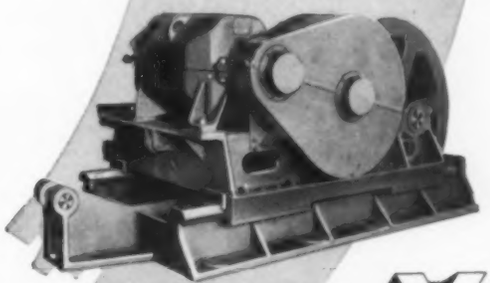
AUTOMATIC RAILROAD SPIKE MACHINE



HOT SAW

WELDED GEAR REDUCER

SCRUBBER and CLEANING LINE



INGOT BUGGY DRIVE

Check this List for the Products You Need

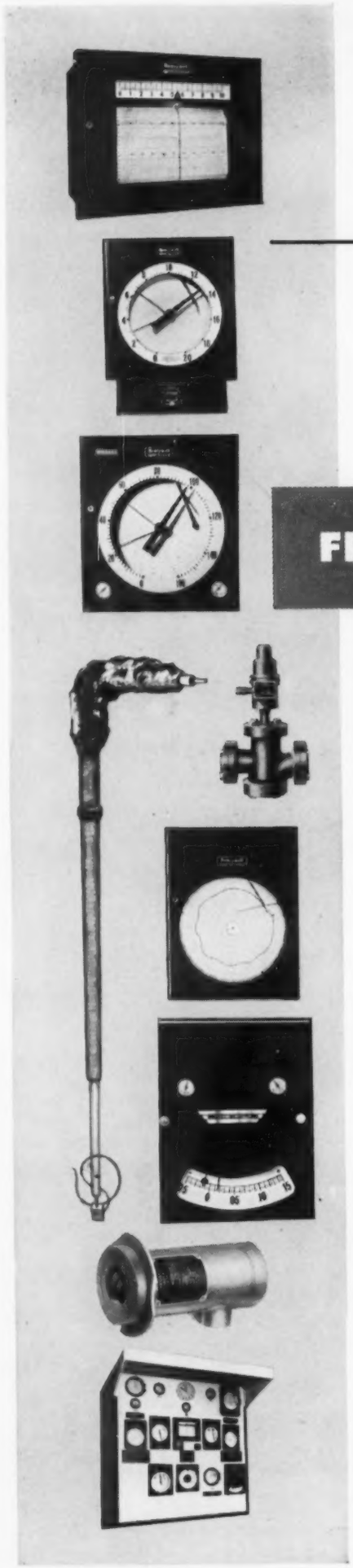
PARALLOY ROLLS (Pinch, Coiler, Tension, Steel Mill)
HYDRAULIC SLAB AND BILLET PILERS
STRIP AND SHEET OILING EQUIPMENT
SHEET SCRUBBER AND CLEANING LINES
HOT SAWS—ROCKING AND SLIDE TYPES
HOT BEDS—COOLING BEDS—TRANSFERS
BILLET EJECTORS—PINCH ROLL STANDS
SLITTERS—SPECIAL SHEARS AND GAUGES
TILTING TABLES—Traveling and Lifting Tables
Continuous PICKLING Lines—ROLLER LEVELERS
FURNACE Charging Equipment—Furnace Pushers
Strip Steel COILERS and REELS—SCRAP BALLERS
RAILROAD Spike Forming Machines—ROLL LATHES
Sheet GALVANIZING Lines—Wire Patenting Frames
Stretcher Levelers—Angle and Shape Straighteners
Rolling Mill Tables—Gear and Individual Motor Types
DUCTILE CASTINGS (80,000 PSI.)

Machinery Built to Customer's Design and Detail Drawings

The Youngstown Foundry & Machine Co.

OVER SIXTY YEARS OF SERVICE TO THE STEEL INDUSTRY

Youngstown, Ohio



Brown Instruments

HELP YOU PRODUCE... MORE EFFICIENTLY... MORE ECONOMICALLY

FROM ORE...TO IRON...TO STEEL

WHEREVER steel is produced . . . wherever it is treated, formed, and fashioned into its innumerable end uses . . . there you will find Brown instruments, control systems and services helping make *better steel*, and *better steel products*, at lower cost.

Brown instruments have advanced through the years . . . with the industry's leaders . . . always in step with the needs of tomorrow, meeting the exact specifications of each new technique.

Brown serves the metals industry by making available:

COMPLETE INSTRUMENTATION—The world's largest selection of unit control systems cover operations ranging from mining ore to automatically controlling the finish of a delicate manufactured product. Every encountered variable: temperature—pressure—pH—conductivity—flow—speed—motion—thickness—smoke—haze—dust—combustion—gas analysis, etc., is efficiently indicated, measured, recorded or controlled.

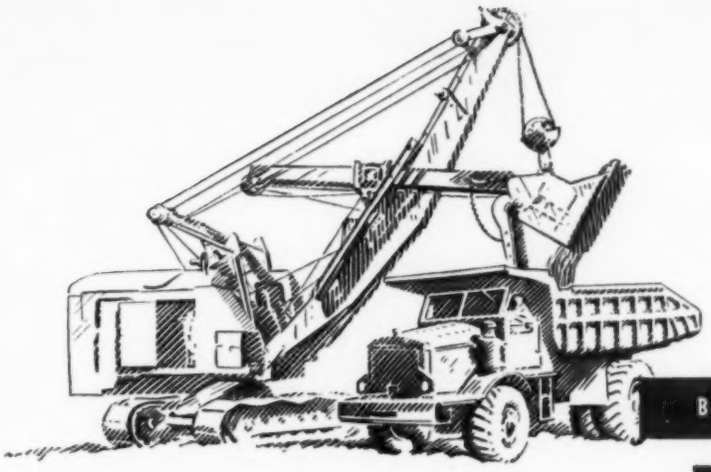
SERVICE AND MAINTENANCE—The world's largest instrument service organization to keep these industries operating at peak efficiency.

TRAINING SCHOOL—trains industry personnel to obtain maximum benefits and continuous life from instruments and control systems.

INDUSTRY SPECIALISTS—located in all major producing areas provide practical, constructive help in industry's problems.

HSM PLAN—makes possible new convenience and savings in the purchase of pyrometer supplies.

COMPREHENSIVE LITERATURE—catalogs, bulletins and specification sheets on products and systems . . . Instrumentation Data Sheets on practical industry applications.



FOR

Beneficiation, flotation, sintering,

kilns, coke ovens, by-product plants,

blast furnaces, electric furnaces,

open hearths, bessemer converters,

cupolas, soaking pits, reheating furnaces,

forging furnaces, roughing mills and

finishing mills, tinning, galvanizing,

pickling, cleaning, and annealing,

plant services and laboratories.

...TO FINISHED PRODUCTS

TO

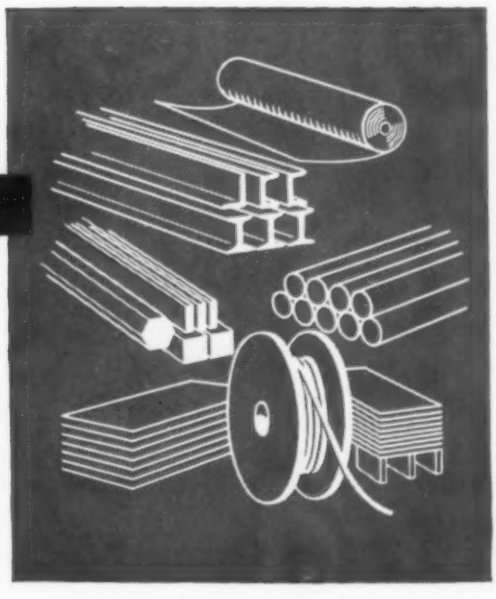
Measure, record and control

(pneumatically or electrically),

pressure, temperature, speed, motion,

thickness, pH, flow, gas analysis,

smoke, haze and dust, combustion.



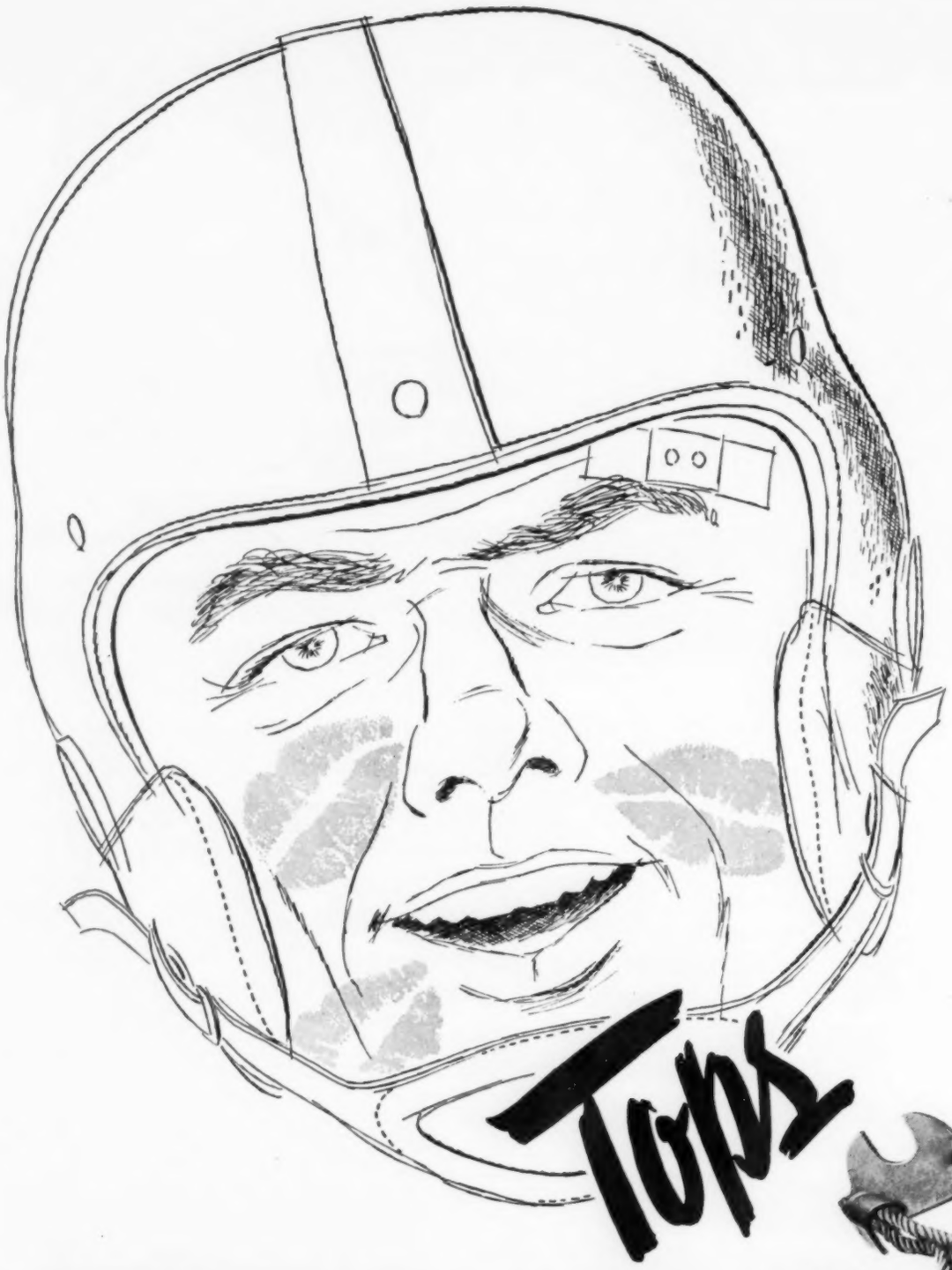
Information on any specific instrumentation problem will be furnished upon request. Write, or call in our local engineering representative . . . he is as near as your phone!

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4464 Wayne Ave., Phila. 44, Pa.

MINNEAPOLIS

Honeywell

Brown Instruments



Tops

LIKE SPEER MULTIFLEX BRUSHES

For Low Energy Loss

U.S. PAT. 2,181,076

SPEER Carbon CO.

ST. MARYS, PENNSYLVANIA

Subsidiaries

Speer Resistor Corp.—International Graphite & Electrode Corp.
Jeffers Electronics, Inc.

7584

PIPE NORMALIZING—

Cut From 5 Hours To 3 Minutes With Continuous Heating Line

SELAS

Gradiation®

MINIMIZES SCALE...IMPROVES GRAIN STRUCTURE

GRADIATION has set another record in this production war—fast continuous heat treatment of vitally needed pipe.

This new Selas technique of heat treating concentrates and accelerates combustion of fuel in a radiant, flameless heat so that *millions of BTU's* are released with precision control in less time and space than required for the release of *hundreds of thousands of BTU's* in conventional heating equipment.

Continuous pipe normalizing with GRADIATION will produce savings:

TIME . . . 5 hours if done by the batch method; 3 minutes with GRADIATION, plus better results.

STEEL . . . surface oxidation minimized . . . no scale . . . fine grained structure produced with GRADIATION.

LABOR . . . no handling between welding and treatment . . . pipe requires no straightening following treatment.

This new continuous pipe normalizing treatment, with its uniformly fine-grained structure, is just one of the many achievements of GRADIATION in the metal industry. Selas engineers are working constantly with leading manufacturers to design, develop and build new equipment—*heat processing equipment* that will speed the products that are needed—*now*.

SELAS CORPORATION OF AMERICA

PHILADELPHIA 34, PENNSYLVANIA

Heat Processing Engineers for Industry — Development • Design • Manufacture

GET big truck advantages at small truck cost with YALE WORKSAVERS

3,000 LB. HIGH-LIFT FORK WORKSAVER

SAVE **TIME AND SPACE.** Move giant loads up to 185 feet per minute—with safe, easy speed control. Utilize *all* storage and production areas.

SAVE **MUSCLE POWER.** Transport and lift capacity loads with a smooth flow of power that's easy on the operator, easy on the load.

SAVE **HANDLING COSTS.** Mechanize handling on low-load floors; in freight elevator operations; and in other areas where weight or space rule out big trucks.

PALLET WORKSAVER

TRACTOR WORKSAVER

PLATFORM WORKSAVER

HIGH-LIFT PLATFORM WORKSAVER

There's a Yale Worksaver to meet your every need

YALE WORKSAVER Electric Hydraulic Lift Trucks are built for loads up to 6,000 lbs., and are ideally designed to accommodate skids or pallets. Their wide acceptance throughout industry is based on the YALE reputation for top performance in electric trucks of *every* kind.

GET AN EYE-OPENING DEMONSTRATION RIGHT IN YOUR OWN PLANT OR WAREHOUSE

Your YALE Representative will demonstrate the cost-cutting advantages of the rugged WORKSAVER line to you. All you have to do is name the time and place. Naturally, there is no obligation.

Be sure to ask about the famous WORKSAVER "package"—*truck, battery, battery charger.* The YALE Selenium Charger saves time by charging WORKSAVERS right on the job.

YALE is a registered trade mark of The Yale & Towne Manufacturing Co.

YALE & TOWNE

MAIL THIS COUPON TODAY

The Yale & Towne Manufacturing Co., Dept. 3411
Roosevelt Blvd. & Haldeman Ave., Philadelphia 15, Pa.

Cutting costs with YALE WORKSAVERS interests me, too.

☐ Please have your local Representative call on me.
☐ Please send me a free copy of the new WORKSAVER Catalog.

Name.....Title.....
Company.....
Street.....City.....State.....
In Canada write: The Yale & Towne Manufacturing Co., St. Catharines, Ont.

YALE GAS AND ELECTRIC INDUSTRIAL TRUCKS • YALE HAND TRUCKS • YALE HAND AND ELECTRIC HOISTS

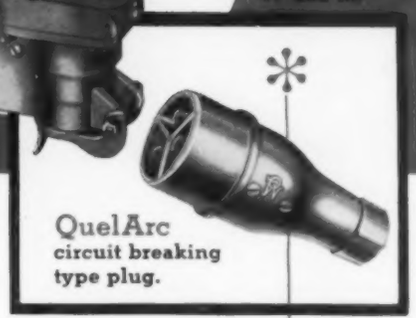
Heavy Duty Safety Switch, and Circuit Breaker

RAIN-TIGHT! DUST-TIGHT!

RAIN-TIGHT SAFETY SWITCHES with receptacle, fusible or fuseless, ratings up to 100 amps, 600 volts . . . without receptacle, up to 200 amps, 600 volts. (NEMA TYPES V, IV and III)

DUST-TIGHT AND RAIN-TIGHT CIRCUIT BREAKERS with receptacle, ratings up to 100 amps, 600 volts . . . without receptacle, up to 225 amps, 600 volts. Dust-tight types for hazardous locations, Class II, group E, F, and G. (NEMA TYPES IX, V, IV and III)

PYLETS



QuelArc circuit breaking type plug.

Designed for Safe, Reliable Operation and Protection of Portable and Stationary Electrical Equipment, indoors and outdoors, under the most severe operating conditions

MUCH LONGER SERVICE LIFE AND LOWER MAINTENANCE COSTS insured by heavy, rust-resisting cast metal construction and rain-tight gasket seals.

COMPLETE SAFETY FOR THE OPERATOR is provided by safety circuit grounding and the interlocking of door and plug receptacle with a quick make and break switch mechanism.

PYLE QuelArc plugs, used with this equipment, are well known industrially, for their unique partitioned construction. Long insulating surfaces from pole to pole, and from poles to ground provide for exceptionally safe handling and long service life.

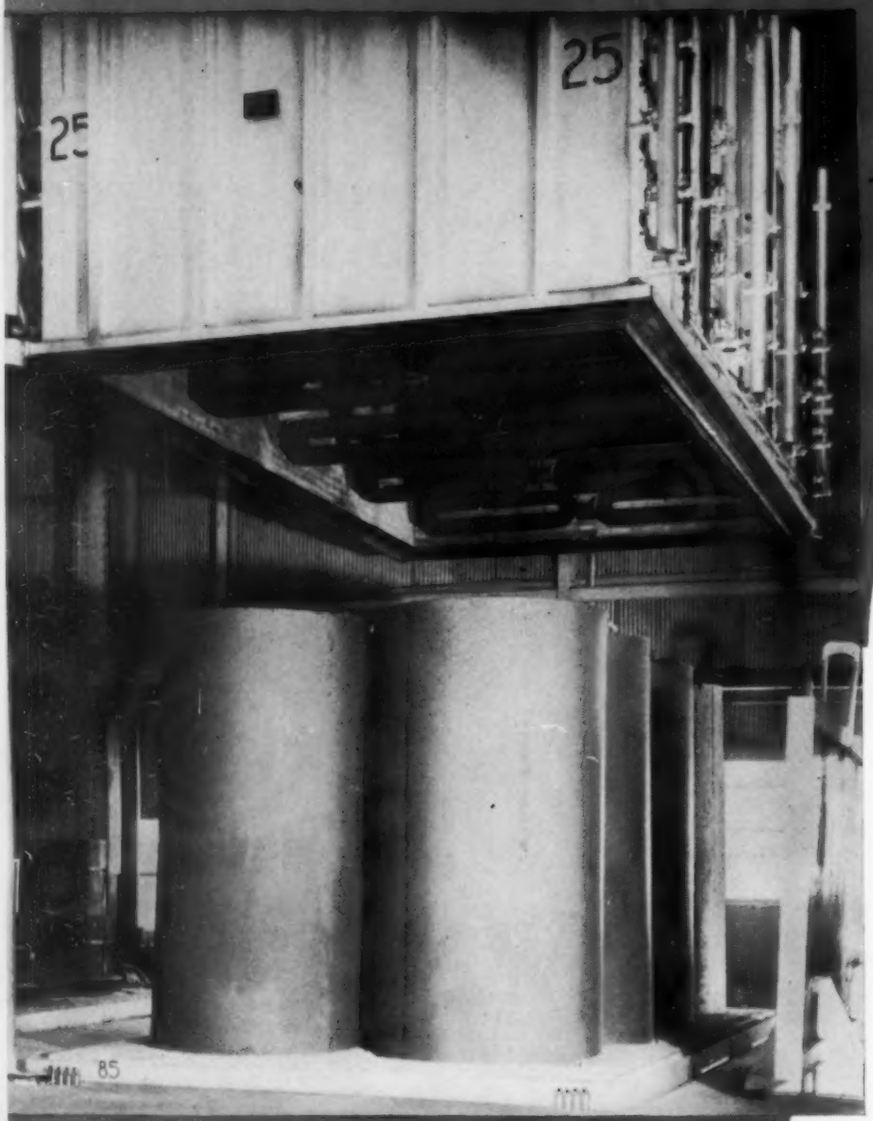
Consult your Pylet Catalog, Bulletin 1150 for complete listings.

SINCE 1897

THE PYLE-NATIONAL COMPANY
1383 NORTH KOSTNER AVENUE, CHICAGO 51, ILLINOIS

District Offices and Representatives in Principal Cities of the United States
Export Department: International Railways Supply Co., 30 Church St., New York.
Canadian Agent: The Holden Co., Ltd., Montreal.

PLUGS AND RECEPTACLES • FLOODLIGHTS • TURBO-GENERATORS • GYRALITES • CONDUIT FITTINGS • MULTI-VENT AIR DISTRIBUTION



Leadership at work!

ONE of
16 COIL FURNACES
installed in a large Midwestern plant—

plus

10 FLAT SHEET FURNACES
installed at the same time

SWINDELL-DRESSLER

RECIRCULATING RADIANT TUBE

In this large Swindell-Dressler installation, each 40-tube furnace is capable of annealing eight stacks per base of sheet steel in 72" O.D. diameter coils, stacked 150" high —aggregating 600 tons of metal per heat.

Let a Swindell-Dressler Engineer consult with you regarding your particular furnace requirements—on any scale, anywhere.

SHEET ANNEALING FURNACES

SWINDELL-DRESSLER Corporation
DESIGNERS AND BUILDERS OF MODERN INDUSTRIAL FURNACES
PITTSBURGH 30, PA.

Less toil per coil on TIMKEN® bearings

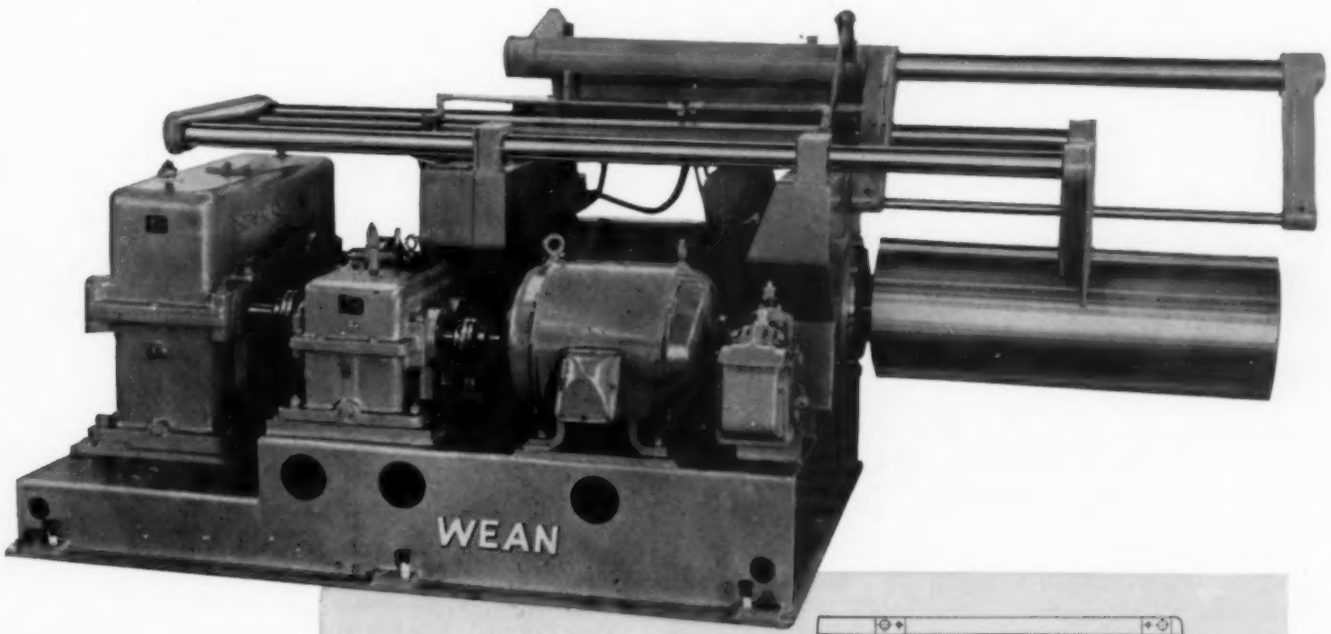
THIS Wean Equipment Corporation recoiler supplies the power for the slitting of wide steel coils and winds the steel as it is slit. To insure maximum ease of operation under the overhung load of steel coils weighing up to 20,000 pounds, Wean engineers have mounted the reel drum shaft on Timken® bearings.

Timken bearings carry both radial and thrust loads in any combination, assure long life and dependable performance. Line contact between the rollers and races gives greater load-carrying capacity.

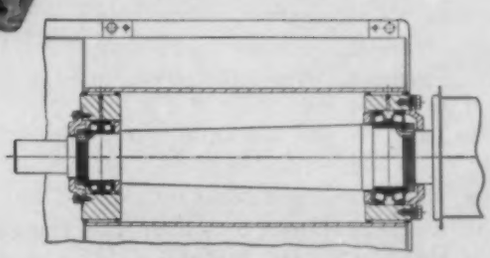
True rolling motion and incredibly smooth surface finish of Timken bearings virtually eliminate friction. And lubrication time and costs are minimized because Timken bearings keep housing and shaft concentric, making closures more effective. Timken bearings normally last the life of the machine in which they are used because (1) they are engineered for the job, (2) they are made of Timken fine alloy steel, (3) they are precision manufactured.

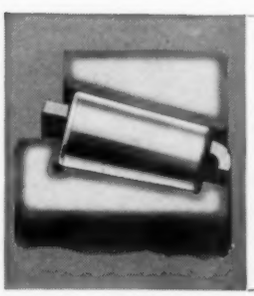
Timken bearings are backed by more than 50 years of experience in bearing research and development. That's why they're first choice throughout industry. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas Ont. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How **WEAN EQUIPMENT CORPORATION** mounts the reel drum shaft of its recoiler on Timken bearings. Timken bearings carry the overhung load with ease, assure long life with a minimum time-out for maintenance.





GREATER LOAD AREA

Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer. The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ◯ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION →✳←

Why don't you do something about Scrap Copper?

A group of us were sitting around the lunch table the other day when Bill Kerr, the President of our Company, brought up the subject of scrap copper. He asked why something wasn't being done about promoting a nation-wide drive for scrap copper. It was his opinion that the shortage of scrap copper is as severe, and possibly even more severe, than the shortage of scrap steel.

That, of course, started a very lively discussion, and in the end we all agreed on one thing — that in the face of a severe copper shortage, plenty of good copper was lying around just waiting to be put back into use.

Joe, the "wag" of our luncheon group, quipped: "Old copper never dies — and it doesn't rust away!" "Hold on, Joe," said one of the other fellows. "There's more truth than poetry in that statement. Did you ever stop to think that just about *all* of the copper that has ever been mined is still around somewhere? It can be found in hundreds of places — in factories, old mines, and especially in shop maintenance departments where old and outmoded spare equipment containing large amounts of copper is stored away. All this scrap copper can be turned back into good, usable copper, which is so desperately needed today."

Well, our conversation resulted in something real and concrete. We launched a "Scrap Copper Drive" right in our own Company and, believe it or not, we found 39 tons of old copper. A lot of it was copper wiring that was abandoned at the time we rewired our plant a few years ago. We even reclaimed copper from an odd assortment of obsolete castings and fittings that was being "saved" for no apparent good reason.

That copper is being sold to a dealer in non-ferrous scrap metal who, in turn, will direct it to a copper company for processing into wire, bus bars, and other vital shapes.

THAT'S WHAT HAPPENED. We're telling you about it because we believe the subject of Scrap Copper is so important, it has priority over the transformer advertisement that was scheduled for this issue.

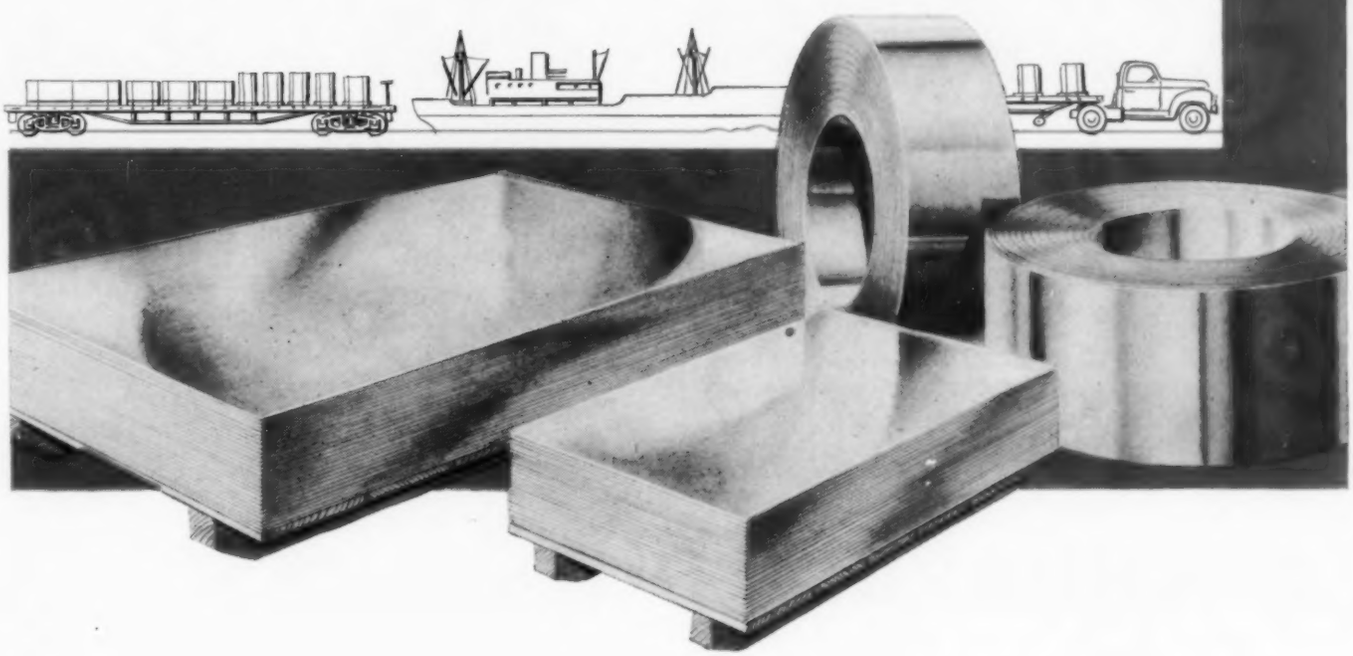
May we suggest that *you* get together with the people in your company and talk about "Scrap Copper." Then, *do something about it!*

Pennsylvania TRANSFORMERS

Pennsylvania TRANSFORMER COMPANY

CANONSBURG, PA. • *Greater Pittsburgh District*

Protect steel sheets and strip during storage and shipment with a Gulf Quality Rust Preventive



Rusting of flat rolled steel products during storage and shipment can be avoided by application of the right rust preventive. But what kind of rust preventive is best? How should it be aplied for best results? Can it be removed easily? Can it be left on during forming and drawing operations? Does it stain during annealing?

One of Gulf's rust-preventive specialists can provide effective help on these probelms. Years of experience in solving all types of corrosion problems, some of which are bound to be similar to yours, make him a logical source of information and advice. Then too, he has access to the facilities of Gulf's modern research laboratory—he can offer you expert assistance in the form of specialized study.

When he has considered every aspect of your problem he will recommend the proper Gulf Quality Rust Preventives, and advise you on the most practical methods of surface preparation and application. The completeness of the Gulf line enables him to select the product which gives the best protection against rusting under the conditions encountered, yet that can be removed economically.

He will be glad to show you some of the many examples of successful application by the steel industry in connection with flat rolled products and shapes. In every case, surface spoilage due to rusting has been eliminated. Write, wire, or phone your nearest Gulf office today.

Gulf Oil Corporation · Gulf Refining Company,
Gulf Building, Pittsburgh 30, Pennsylvania.

FIFTY YEARS OF SERVICE
1901 GULF 1951
PETROLEUM AND ITS PRODUCTS

Gulf Oil Corporation · Gulf Refining Company ISE
719 Gulf Building, Pittsburgh 30, Pa.

Please send me, without obligation, a copy of your pamphlet "Gulf Rust Preventives."

Name.....

Company.....

Title.....

Address.....

For general-purpose motors and generators . . .

NATIONAL
TRADE-MARK

STANDARDIZED BRUSHES

For general-purpose motors and generators, such as widely used SK, CD and many other types, there are no better brushes than "National" STANDARDIZED Brushes and no better grades than NATIONAL CARBON's 255 and SA-35. Each brush has been well built for its specific job. Both grades, 255 and SA-35, have been proved dependable by many years of satisfactory service in leading mills. Here are the plus values:

- **Unequalled uniformity**
- **Give most efficient machine operation**
- **Require minimum machine maintenance**
- **All at a *low flat price*, for one box or 10,000 boxes!**

The term "National" and the Three Pyramids Device are registered trademarks of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N.Y.

District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

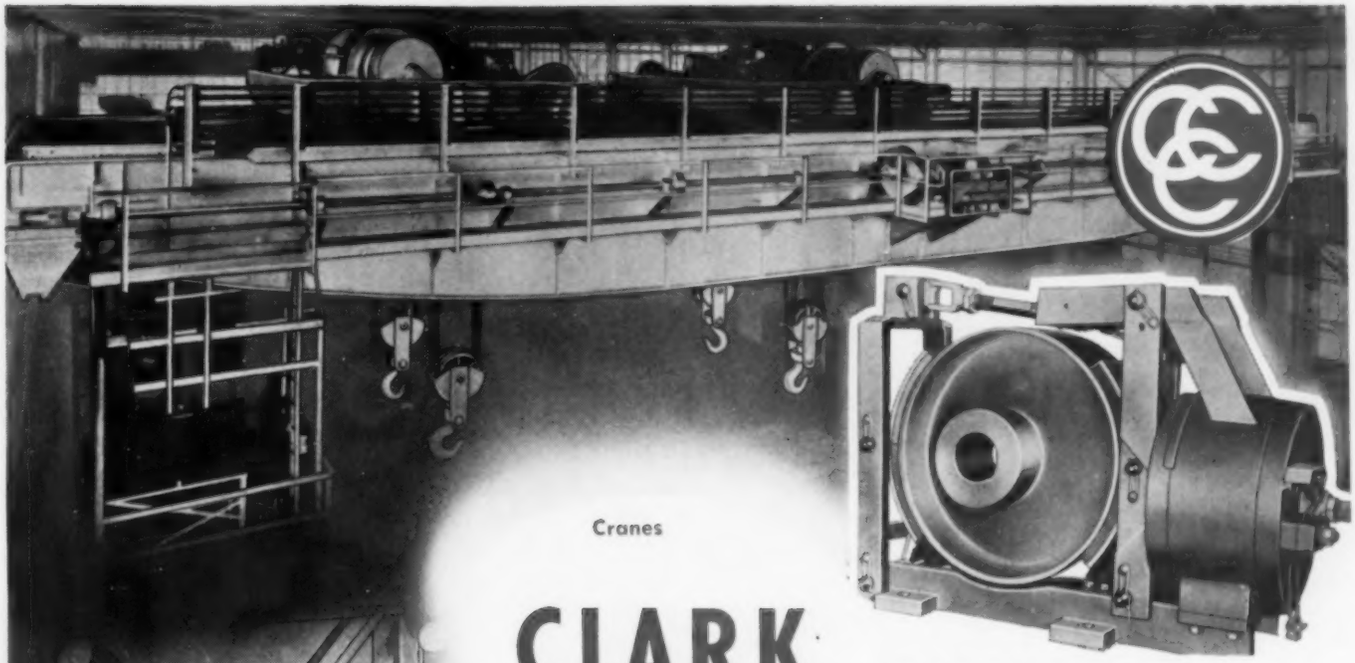
IN CANADA: National Carbon Limited
Montreal, Toronto, Winnipeg

STANDARDIZED BRUSHES
FOR GENERAL-PURPOSE MOTORS AND GENERATORS

NC NUMBER	SPECIFICATIONS	APPLICATIONS
NC 12-3202	1¾ x 1 x ⅜ Grade 255	Type SK Motors and Generators
NC 12-4001	1¾ x 1¼ x ⅜ Grade 255	Type SK Motors and Generators
NC 20-4002	1¾ x 1¼ x ⅝ Grade 255	Type SK Motors and Generators
NC 12-4003	2 x 1¼ x ⅜ (15/15° bevel) Grade 255	Type CD Motors and Generators
NC 16-3205	2 x 1 x ½ (15/15° bevel) Grade 255	Type CD Motors and Generators
NC 12-4802	2⅛ x1½ x ⅜ (35/20° bevel) Grade SA-35	Type CD Motors and Generators
NC 16-4804	2¼ x1½ x ½ (35/20° bevel) Grade SA-35	Type CD Motors and Generators

Order by NC Number

FOR COMPLETE INFORMATION on NATIONAL CARBON'S brush standardization program and the advantages it offers, write to National Carbon Company, A Division of Union Carbide and Carbon Corporation, Dept. IS.



Cranes

CLARK

Clark Bulletin 106 D. C. Shoe Brake

BULLETIN 106 DC BRAKES

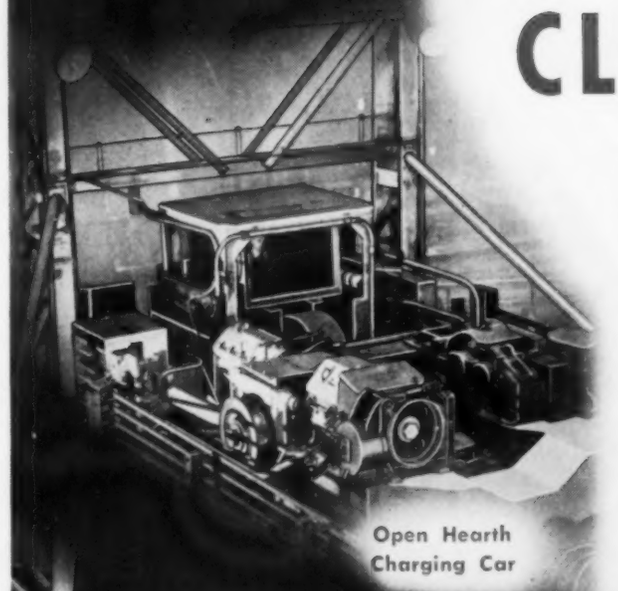
For Every Heavy-Duty Mill Application

● These brakes are making records daily in many heavy-duty, tough mill applications. They give complete satisfaction, with minimum maintenance.

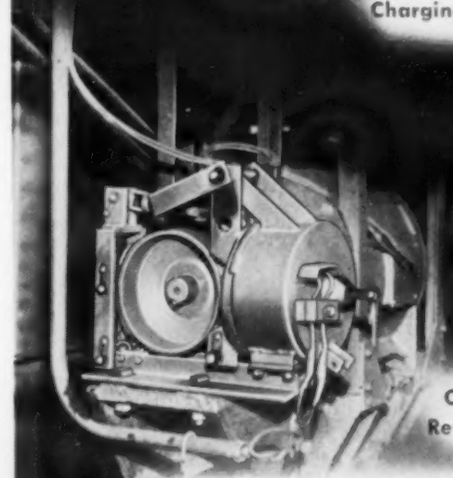
After installation there is only ONE adjustment, and that's for lining wear.

And that adjustment is on TOP! Not on the sides; not on the ends; not on the bottom, but on TOP, where you can see it and get at it easily.

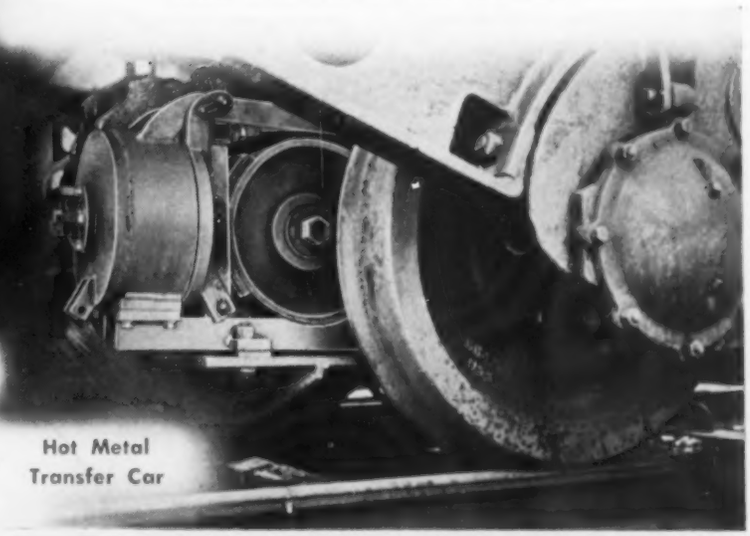
Here is simplicity that counts!



Open Hearth Charging Car



Open Hearth Reversing Valve



Hot Metal Transfer Car

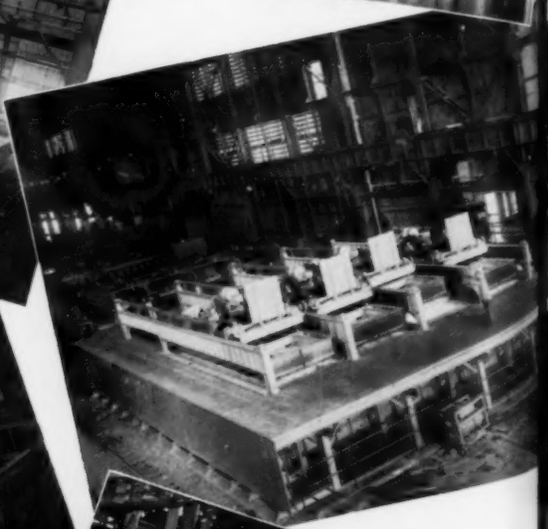
Consult our nearest Representative to solve your braking problems

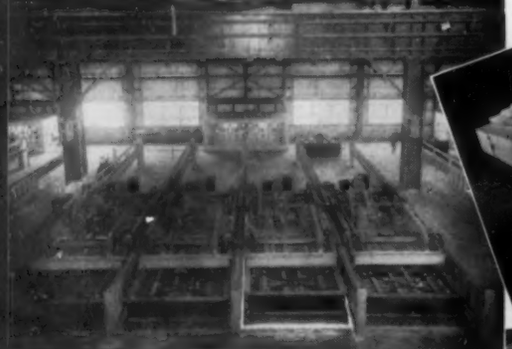
THE CLARK CONTROLLER CO.

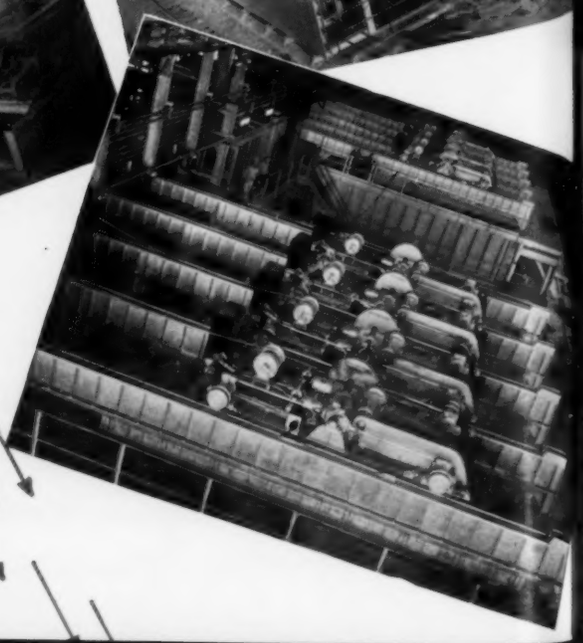
ENGINEERED ELECTRICAL CONTROL • 1146 EAST 152ND STREET, CLEVELAND 10, OHIO

PROOF!

ONE-WAY FIRED PITS



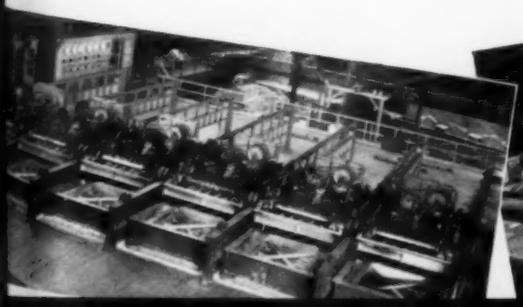




...by performance

During the past quarter century, 'Surface' One-Way Fired Soaking Pits have gained recognition in America's leading steel mills. The uniformly high quality and tremendous tonnages of steel turned out by these soaking pits are proof that the 'Surface' "one-way firing" principle is the most satisfactory method of ingot heating.

'Surface' "one-way fired" pits employ the new jet pump recuperative system to combine the durability of the refractory recuperator with the efficiency of the metallic recuperator. Ask your 'Surface' engineer about it.



SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

FOREIGN AFFILIATE COMPANIES

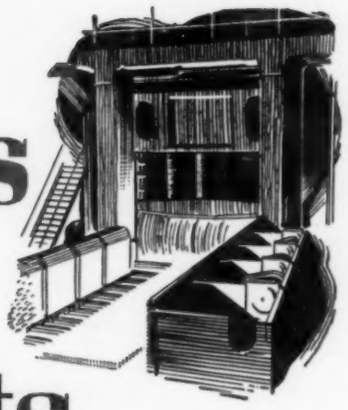
BRITISH FURNACES LIMITED—CHESTERFIELD
STEIN & ATKINSON, LTD.—LONDON
STEIN & ROUBAIX—PARIS, LIEGE AND GENOA
WILL L. SMITH, S.A.—BUENOS AIRES

'Surface' SERVES THE STEEL INDUSTRY

One-Way Fired Soaking Pits • Billet Reheating Furnaces • Slab Heating Furnaces • Continuous Type, Controlled Atmosphere Strip Annealing and Normalizing Furnaces • Controlled Atmosphere Annealing Covers for Wire and Rod • Controlled Atmosphere Annealing Covers for Coil and Sheets • Continuous Furnaces for Heat Treatment of Steel Plate • Controlled Atmosphere Furnaces for Carbon Correction in High Alloy Rod and Bar Stock • Continuous Type Bright Annealing and Normalizing Furnaces • Prepared Gas Atmosphere Generating Equipment • Pit Type Convection Furnaces for Rod Annealing • Stress Relief Furnaces • Wire Patenting Furnaces

15 TON
CLEVELAND CRANE
2-7½ TON HOOKS
Cleveland Cranes
FOR
STEEL MILL SERVICE
CLEVELAND CRANES
MODERN ALL-WELDED STEEL MILL CRANES
5031 EAST 289th ST.
WICKLIFFE, OHIO

Crops *and* Shorts



WITH very few exceptions, reports from steel companies for the first three-quarters of 1951 follow the same general pattern of increased production and sales with decreased net income, due principally to higher taxes and increased costs of purchased goods and services. Since this is in direct contrast to industry in general, which showed increased net income, it is certain that any advance in wages, as now being agitated by the United Steel Workers, will bring on higher steel prices.

▲

A CORRESPONDENT tells us that he has the real dope on when World War III will begin. He has it scheduled for 25 minutes after Joe Stalin says Margaret can't sing.

▲

ANOTHER correspondent, apparently surfeited with propaganda from the recent election, says a candidate is a person who stands for what he thinks people will fall for.

▲

ANNOUNCEMENT has been made of the completion in Belgium of a pilot plant for the continuous casting of billet-size steel ingots. This unit is designed on the Jacquet patent as reported in the Iron and Steel Engineer for January, 1951, and the results of preliminary tests are said to be quite favorable and up to expectations.

▲

IN the past 30 years population of the United States has increased about 45 per cent, and the number of employed people in the country grew in the same proportion. During those three decades, however, government civilian employment multiplied by 2.5 times. And the Continental Congress said George III was tyrannical because "He has erected a multitude of new offices, and sent hither swarms of officers to harass our people, and eat out their substance."

▲

IT appears that the steel industry, after a considerable period of hesitancy, is accepting the principle of high top pressure on blast furnaces. Eight furnaces in the United States and one in England are now operating under high top pressure. Also in the United States, six large furnaces now under construction are being designed for this operation and five old furnaces are being converted.

COULD it be that the reason a dollar won't do as much for us as it once did is because we don't do the work we used to do for a dollar?

▲

STATISTICS issued by the Automobile Manufacturers Association indicate the extent to which our national economy is linked to automobiles. There were 49,176,796 motor vehicles in the United States in 1950, (one for every 3.1 persons) with 62,200,000 drivers. The average age of these vehicles was 14 years (120,000 miles). In 1950, 8,003,045 motor vehicles were sold, and 20 per cent of all retail sales in the country were automotive.

▲

YOUNG men usually think they can save the world, but as they progress toward middle age they begin to wish they could save part of their salary.

Incidentally, middle age can be defined as the time when a night out is followed by a day in.

▲

ENCOURAGED by the results of the basic economics course which it is jointly sponsoring with University of Chicago, Republic Steel Corp. is extending the course to include more than 6000 of the company's foremen and supervisors. Some 3000 Republic men have already completed the course, which is taught principally by instructors selected from the Republic organization and trained at University of Chicago. Fifteen specially prepared booklets, discussing budgets, prices, production, wages, costs, profits, money and banking, inflation, Republic's economic and financial position, etc., form the basis of the course.

The course was started in the belief that many of our country's economic woes stem from a general lack of understanding of our economic system, and it was designed to overcome that fault by stimulating people to think more clearly about this system.

▲

FROM the Louisville Courier-Journal:

Chivalry's what makes a man,
At the risk of life and limb,
Defend a lady's honor from
All other wolves but him.

▲

ACCORDING to the American Iron and Steel Institute, the geographic center of United States steelmaking capacity is now about one mile north of Mt. Cory, Hancock County, Ohio. This is about 14 miles northwest of the 1945 center at Dola, Hardin County, Ohio.

▲

THE Wage-Hour administrator has ruled that, under provisions of the wage-hour law, traveling employees must be paid for time he's on the road during customary sleeping hours unless he gets some sleeping arrangement and gets "reasonably appreciable" good out of it. His pay stops at his normal time — say 5:00 p.m. — and starts again at 11:00 p.m. if he does not have a berth. What? No pay from 5 to 11? That's when a lot of traveling men do their best work!

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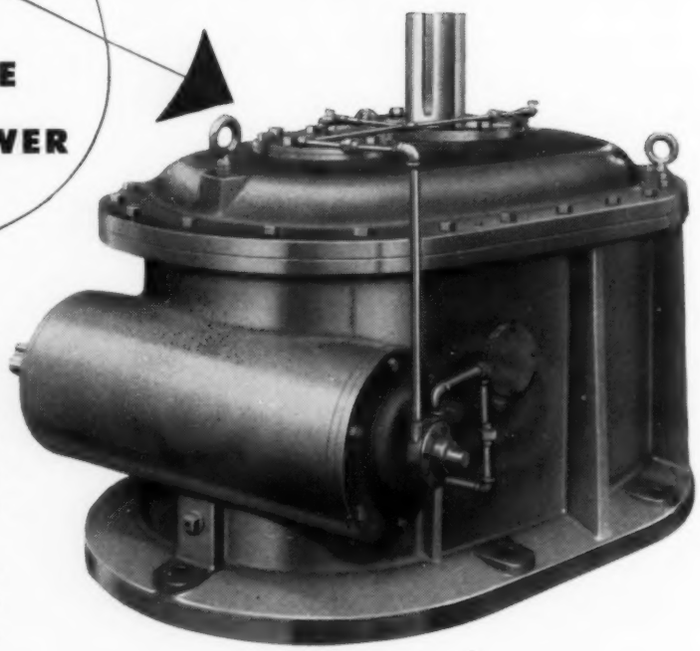

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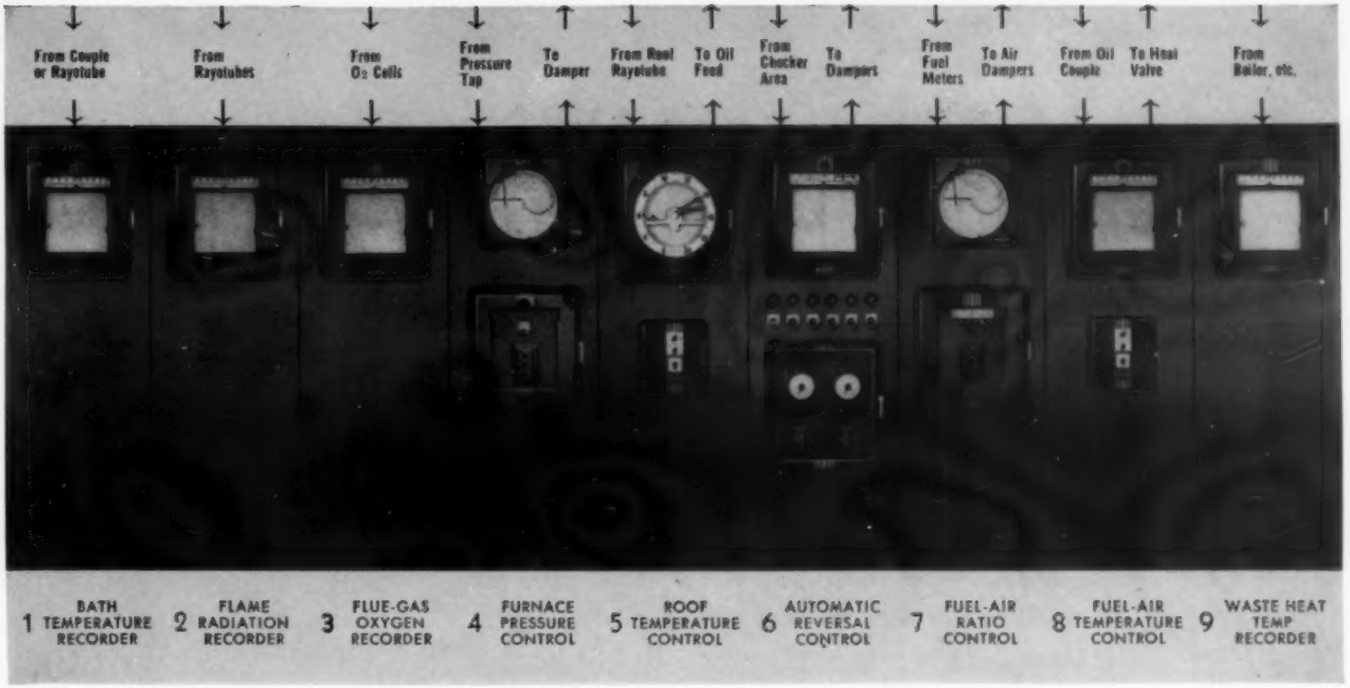

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Iron AND Steel ENGINEER

NOVEMBER, 1951 VOLUME XXVIII NUMBER XI

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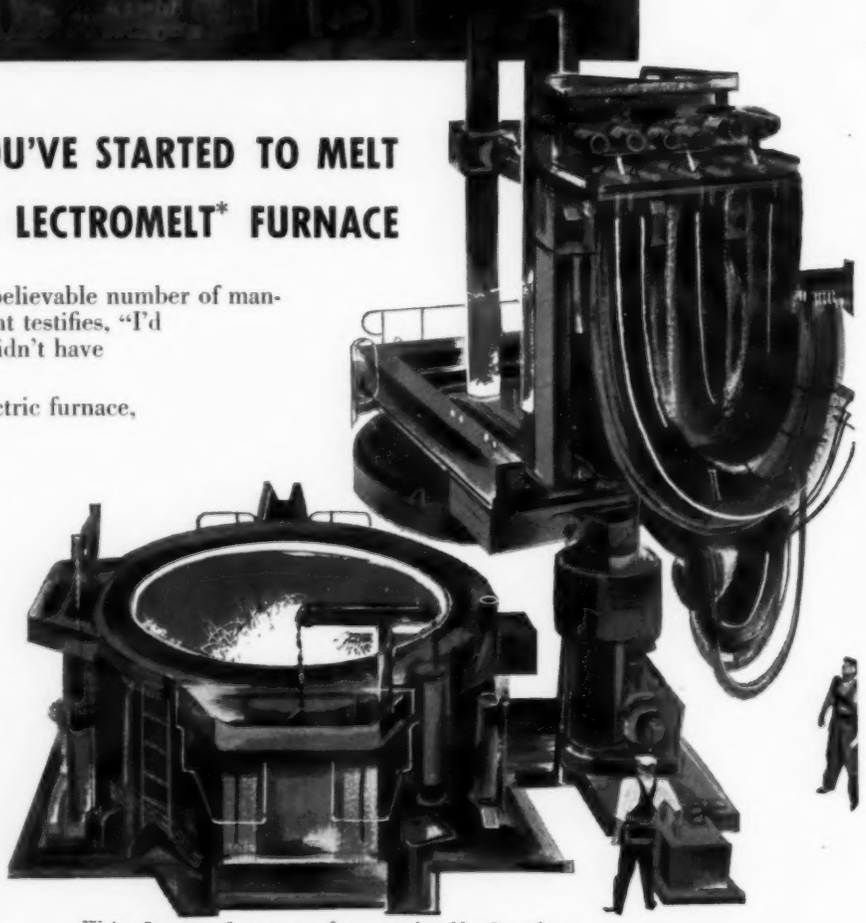

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WHEN YOU MELT... *Lectromelt*

"How to Organize an Engineering Dept."

.... A ROUND TABLE SYMPOSIUM ....

.... discussion gives opinions of experienced engineers on the divisions and functions of an engineering department in handling a large number of projects through each of their respective steps ....

.... by F. M. Darner

Chief Engineer

Manufacturing Divisions

Republic Steel Corp.

Cleveland, Ohio

▲ THE idea back of this discussion is the desire to improve the organization of a plant engineering department. Some time ago Mr. Chaffee gave a paper before the Cleveland Engineering Society on engineering department functioning as it applied to a consultant's office. Some of us who attended this meeting began to discuss the relative problems of a plant engineering organization. We decided to try the presentation of the subject before the AISE in an endeavor to stimulate thinking by a larger group of engineering department supervisors with the end point of general improvement of an engineering organization that would function more smoothly, be more systematic, and give those in charge more time for the solution of engineering problems.

Our first problem in arranging this symposium was how to present the subject in such a way that would hold interest and encourage discussion. We have selected the so-called round table method in order to present the solutions of several engineers. We will start with the presentation of existing engineering organizations and how they function in their respective organizations.

... by Leonard Larson

Chief Engineer

Corrigan McKinney Plant

Republic Steel Corp.

Cleveland, Ohio

▲ THE engineering department organization outlined on Figure 1, employing about 65 people, is charged with the following functions in an integrated steel plant operating ore handling facilities, five blast furnaces, sintering plant, five batteries of coke ovens and by-product plant, 15 open hearth furnaces, two blooming mills, two bar mills, strip mill, auxiliary shops and power generating facilities:

1. Maintaining records of plant property, buildings and equipment.
2. Furnishing services as needed in connection with routine operations and maintenance work.
3. Handling of major maintenance programs where some alterations in design are involved and/or expenditures are high, requiring estimates and management approval before proceeding with the work.
4. Estimates, layouts, analyses and reports on new ideas.
5. Handling all work in connection with painting and maintenance of plant buildings.
6. Handling design and construction for new facilities, including:
   a. Preliminary estimates and reports.
   b. Specifications and inquiries.
   c. Final estimates and appropriation requests.
   d. Tabulating and classifying bids on new equipment.
   e. Handling of contract service on maintenance and new construction.
   f. Setting up construction schedules.
   g. Buying materials and equipment, in conjunction with central purchasing department.
   h. Supplementing central purchasing department in expediting construction materials and equipment.
   i. Compiling construction costs and progress reports.

Obviously the process of developing new equipment, although handled by the engineering department, is not entirely confined to the personnel and talents of the engineering department only. We work in harmony with operating and other service departments, so that the final result reflects not only the engineering department, but rather the whole organization. The average steel plant engineering department has numerous bosses or customers, if you please, to keep it busy.

All jobs or assignments coming to the department, aside from those of a routine nature, are given a pro-

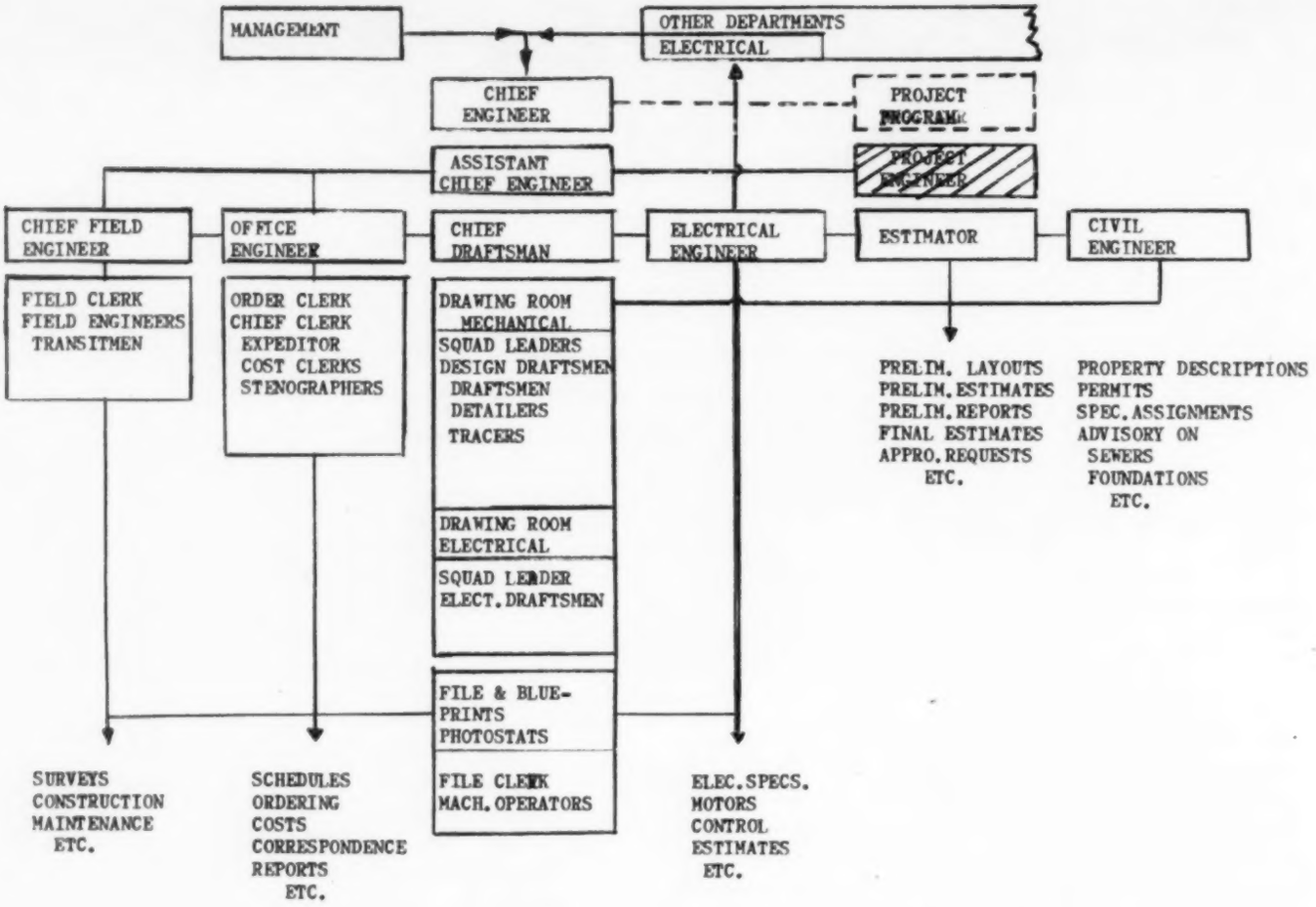


Figure 1 — Organization diagram for plant engineering department at Republic Steel Corp.'s Corrigan McKinney plant.

posal number. It is desirable and customary to obtain as much information pertaining to these assignments as possible when received, to fully understand the need and expectancy from the job. If additional information is needed for making an intelligent analysis, this is then secured, from whatever source that may be available, but usually through the industrial engineering department, a separate department in our company.

Following receipt of complete information, and as soon as consistent with other work, a preliminary proposal is made up for distribution to district management and all interested parties. This proposal, accompanied by preliminary layout or sketch, sets forth the following information:

1. Objective.
2. Brief history and background.
3. Recommended procedure.
4. Preliminary estimate of cost, return and savings, if any.

Each recipient of the preliminary report is requested to return his approval or comments on the program. If approved, it is referred to district management for disposition before doing any further work. If comments dictate or justify a change in program, it is revised and resubmitted.

Upon approval of all interested parties, followed by approval of plant management, it becomes another job in the schedule.

The preceding procedure is intended to accomplish:

1. Clarify the project and obtain pertinent comments or suggestions before proceeding with details.
2. Minimize and, if possible, eliminate embarrassing aftermaths, or misunderstandings.
3. Promote more efficient work in drawing room.
4. Minimize unnecessary detail work in connection with projects that do not measure up to expectancy.

The overall scope of work and personnel may be divided into the following general categories:

1. Routine service and maintenance.
2. Project work, including preliminary layouts and proposal reports, and on the projects which meet with favorable response, making up final estimates for formal appropriation requests to top management.
3. Design work in connection with approved projects.
4. Procurement of materials and equipment.
5. Construction.
6. Costs.

Drawing room personnel is utilized on project development or approved appropriation work according to demand or prevailing distribution of work in the above categories.

The foregoing pattern of organization and procedure

represents what we consider the most effective set-up, and the end toward which we are working. Its attainment is somewhat hampered by difficulties in getting or developing competent manpower, particularly on key positions, with a view toward an efficient and fast moving department.

. . . . *by George S. Monks*

Chief Engineer (Retired)

Otis Works

Jones & Laughlin Steel Corp.

Cleveland, Ohio

▲ IN a manufacturing plant of any size all engineering problems should be centralized in an engineering department under the supervision of a competent head. If it is a single plant he will organize a central department to aid him. If it is a large organization with a number of plants he may elect to centralize all major engineering at one main office, or to decentralize with an engineering department at each plant, or some combination of the two where some of the operations do not justify establishing a separate plant engineering department capable of handling all problems which might arise.

In Figure 1 is shown an example of a decentralized engineering organization where each major plant division has an engineering organization of its own. Where close cooperation must be maintained between operating and maintenance personnel and the engineering department it is advisable in the interest of efficiency to have the engineers close to the plant, assuming of course that the volume of work justifies an engineering force continuously.

ORGANIZATION CHART

The chief engineer and his staff controls all appropriations for improvements, and is consultant on all operating problems involving the equipment, properties, product, etc.

Each plant has its own engineering department headed by a resident chief engineer. There are exceptions. The raw materials division has a centralized engineering department for mines and quarries.

One of the plant engineering departments is the central engineering department for barrel plants, marine ways, tube weld division, etc. where a separate department cannot be justified.

In the typical case shown in the chart, the resident engineer can divide the plant geographically, or by plant division or any manner he finds advantageous, with a competent squad leader assigned to handle the projects in that division. As shown, one supervisor is assigned to the rolling of steel, both hot and cold. Another is assigned to the division of the plant making the iron and steel.

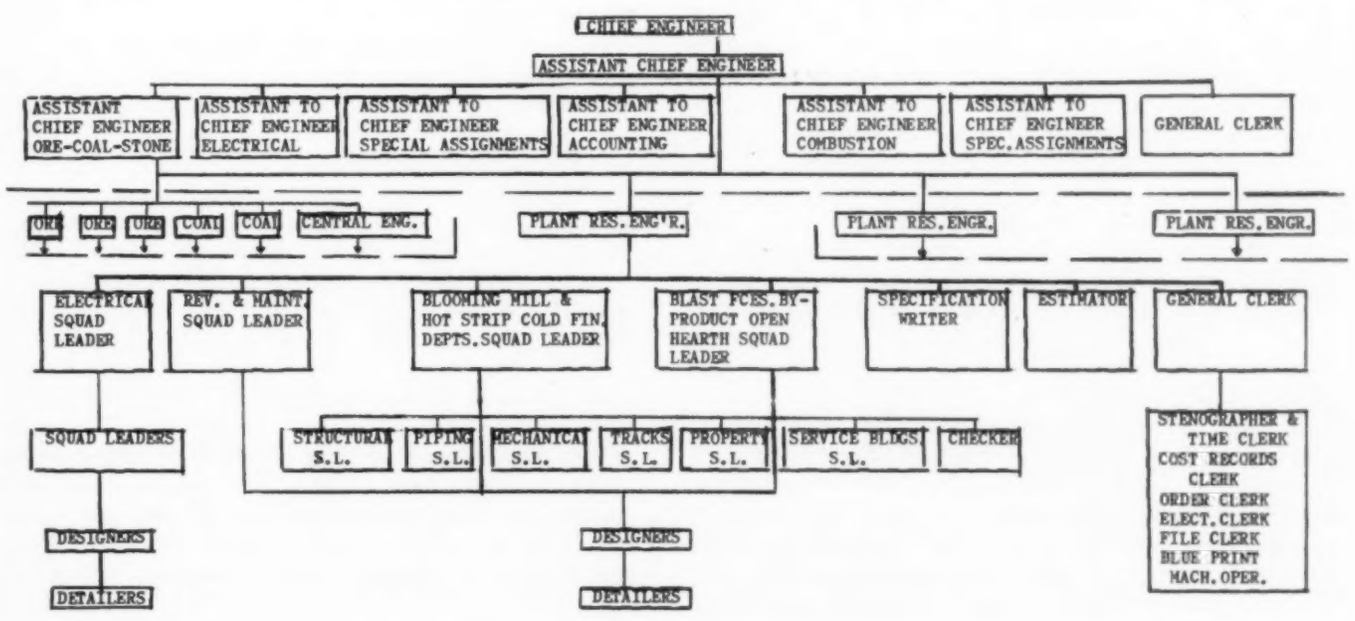
These leaders are supported by a staff of specialists and advisors on structural, piping, pumps, etc., mechanical and foundations, tracks, property, service and small building, so that all phases of a project are taken care of by competent men. A pool of designers and detailers is available to make the drawings.

All electrical problems are handled by an electrical squad leader with two or more squad leaders under him to cover variations in the work. He also has some designers and detailers.

A squad leader is assigned to give service to the millwrights in their maintenance problems.

To standardize on specifications for all equipment and services, a competent man has been trained in their preparation.

Figure 1 — Engineering organization for Otis works of Jones & Laughlin Steel Corp.



An estimator is required to assemble new estimates and to keep a running check on the status of all open accounts.

A clerical division headed by a general clerk takes care of stenographic work, cost records, ordering, files and print room.

It will be noted that there is no chief draftsman. The duties ordinarily covered by this post are divided among the supervising squad leaders and chief clerk. It is admitted that some of the functions of an ideal engineering organization are slighted, such as close supervision, training, standardization of practice. A chief draftsman should be included to cover these functions and to keep the supervising squad leaders free to follow the engineering of their projects.

This organization does not prepare the justification for proposed improvements. This function is handled by the industrial engineering division.

A separate construction engineering division supervises the installation after the drawings and orders are issued.

A separate construction accounting division assembles all costs and keeps the engineering department and the management informed on the status of accounts and a check on proper accounting.

ENGINEERING PROJECTS

Where no appropriation is required for an engineering project, approval must be obtained from plant general superintendent only before proceeding with designing and detailing.

Where an appropriation is required the idea is submitted to the plant general superintendent who refers it to the engineering department for preliminary layout and preliminary estimate, and to the industrial engineering department for preliminary justification. A request form is then made out asking approval signatures of the plant general superintendent and the corporation chief engineer.

When approved, the project is assigned to a squad leader who will develop the engineering to the point where it is known definitely how everything necessary is to be done and what quantities of material and services will be required, obtaining preliminary bids from suppliers through the purchasing department if necessary. This is done in collaboration with the plant management, operation, construction and maintenance forces and the corporation chief engineer with his assistants.

When approved, an appropriation estimate and request is prepared. When granted, detailing and ordering can proceed. Any departure from original plans must have top management's approval. Therefore costs must be closely watched and changes in design or improvements are to be made only with the approval of top management.

If necessary, outside engineering firms may be employed to aid in planning as well as final detailing.

When the requisition is written the construction department installs the work in the field. The engineering department, however, must be constantly in touch with the work, explaining the drawings, taking care of errors and interferences and oversights, inspecting and approving, aiding in starting and proper functioning of the installation.

RESPONSIBILITIES OF THE PLANT ENGINEER

In connection with each improvement project the engineering department has the following responsibilities:

1. Preparation of preliminary studies.
2. Investigation of existing installations for possible improvements.
3. Preparing a construction sequence schedule in collaboration with construction, maintenance and operating departments.
4. Estimating costs.
5. Preparing specifications.
6. Sending bid requests to the purchasing department.
7. Negotiating with suppliers and contractors after they have been called by the purchasing department.
8. Analysis of bids.
9. Issuing requisitions for all materials and services to the purchasing department and/or to other company departments.
10. Collaborate with purchasing department on claims.
11. Contracting through purchasing department for outside engineering help and supervision of their work.
12. Developing final layouts and obtaining approval of interested parties.
13. Designing special equipment.
14. Designs and details of machinery, structures, piping, electrical facilities, foundations, etc.
15. Selection of proper materials and equipment.
16. Inspection and approval of work in suppliers' shops and factories.
17. Follow the functioning of the apparatus when installed.
18. Assist in performance tests.
19. Maintain contact with construction in the field.
20. Approve bills against requisitions.
21. Keep a running check of commitments against appropriation accounts to guard against over expenditure.
22. Submit supplementary appropriation requests where changes in scope of the work, type of equipment or unanticipated increase in cost is encountered.

This organization will handle all engineering projects in the plant whether large or small. If small, they will do the designing and detailing. If large, outside engineering firms must be employed and the supervising squad leaders with the assistance of the staff of specialists at his command will supervise the work of the contractor.

If it is the management's policy not to employ outside engineering help, then the force of designers, detailers and clerical help must be expanded to suit with increase in building space and help in other departments. In these days of social security and the desirability of employment continuity, expanding the force and reducing it at the end of a project is to be avoided. The engineering contractor is ready and willing to perform this service.

. . . . by C. A. Butler

Director of Engineering

Diamond Alkali Co.

Cleveland, Ohio

▲ THE central engineering department is a headquarters division of the Diamond Alkali Co. which operates twelve plants of various sizes widely separated geographically, all engaged in the production of heavy chemicals. The three largest of these plants have limited plant engineering departments which are adequate to take care of maintenance engineering, day-to-day engineering problems and small alterations or additions that do not involve highly technical considerations. The central engineering department handles only the larger projects in these plants, but in the smaller plants must handle all of the engineering problems which cannot be taken care of by the engineering forces.

The department is responsible for executing preliminary engineering studies and analyses for contemplated new plants and major additions or revisions to existing plants when requested to do so by the president or executive vice president, and for performing complete engineering and construction services on designated major projects.

This department is organized to function as a service organization. Service is rendered primarily to the operating departments as far as design and construction is concerned, and to company management as far as economic studies and special assignments are concerned. The organization must handle projects of all sizes and of any type coming within the scope of company activities. One man is in responsible charge over all phases of the design of each project.

RESPONSIBILITIES OF KEY PERSONNEL

The functioning of the organization can best be understood by considering the basic functions of the key personnel:

Director of engineering is responsible for all activities of the department and for executing special assignments made by the president or executive vice president.

Chief design engineer is responsible for the design of all projects assigned to the central engineering department for engineering.

Design engineer is responsible for the engineering design of assigned projects.

Construction engineer is responsible for the construction of assigned projects, for maintaining up-to-date estimating cost data, and for maintaining firm up-to-date estimates of field costs of all central engineering projects after completion of all engineering drawings and specifications.

Staff engineer is responsible for executing technical assignments made by director of engineering, primarily preliminary engineering and economic studies and analyses, investigation of general areas or specific locations with respect to natural resources, and development of standards for engineering design and for materials and construction.

Office supervisor is responsible for drafting, clerical, stenographic, filing and reproducing services necessary in departmental activities and for operation of the building housing the department.

Engineering draftsman is responsible for making layouts, detailed design calculations, general and detailed drawings, checking and acting as squad leader upon assignment.

The duties of others in the organization are evident from their designations.

TECHNICAL AND ADMINISTRATIVE RESPONSIBILITY

It will be noted on Figure 1 and in the job summaries just given that the technical duties of the department are handled by the design and staff engineers who also have the technical supervision over the draftsmen.

Field construction is essentially an administrative endeavor rather than a technical one. The duties of the construction engineer and his assistants and the office supervisor and his staff are administrative not technical.

With this arrangement the technical specialists are not burdened by administrative duties, and on the other hand, the supervisors in the organization whose duties are primarily administrative may be selected for their ability and experience along these lines regardless of whether or not they have a high order of technical ability.

SOURCE OF REQUESTS FOR ENGINEERING SERVICES

The relations of this department to other departments in the company are kept as closely as possible similar to relations between an independent consulting engineering firm and its client. Most requests for the design of improvements or alterations to existing plants originate in the operating departments.

Requests for the engineering of projects involving increased plant capacities for established products usually originate in the form of a joint request from the sales and operating departments.

Requests for consideration, economic study and design of facilities for new products and processes usually originate from sales, research and technical service or from top management.

PROGRESS OF PROJECTS

The progress of a project through the department is usually as follows:

1. The project is referred to a staff engineer for economic study.

2. The staff engineer consults with proper operating department officials, and if the study involves new products and processes or possible process improvements, research and development are also consulted and a preliminary report is made up.
3. If the preliminary report indicates the project is desirable, the staff engineer makes up a request for engineering approval which is presented to management.
4. Upon approval for engineering, the project is assigned to a design engineer. The design engineer's first activity is to prepare a design report which includes material balances and flow sheets, taken after checking from the staff engineer's department for preparing to start up the installation.
8. The design engineer is on hand at the start-up to cooperate with the operating department in making the installation work as planned, and, if necessary, to engineer required changes to make the installation work properly. When the facility is working properly, a third issue of the design report which includes changes made during start-up and reasons therefore, is written.
9. The project is not considered complete until a fourth and final issue of the design report is compiled, which includes all cost data and final records of drawings, orders, specifications, etc. in addition to the information included in the first three issues.

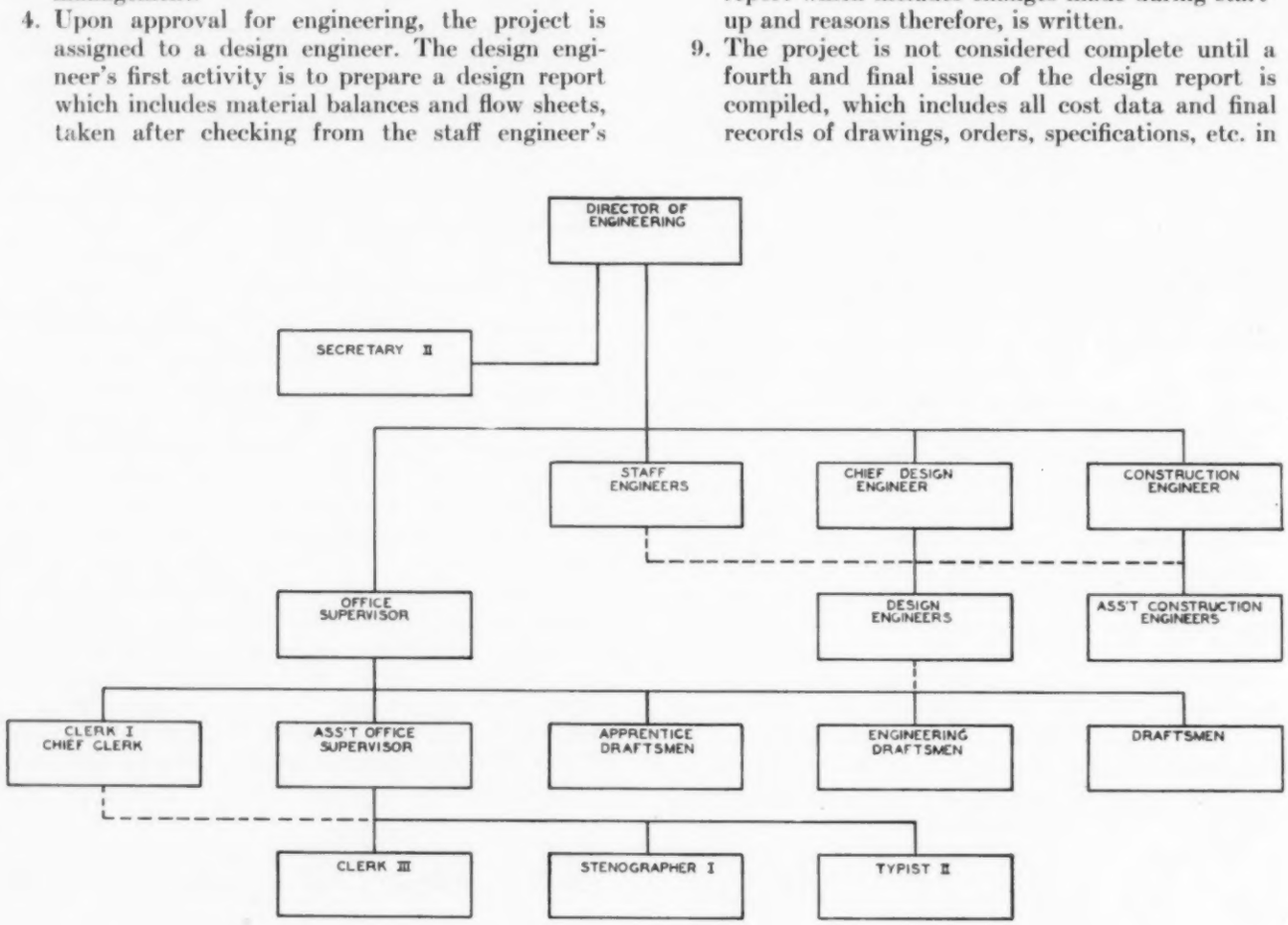


Figure 1 — Table of organization of central engineering department, Diamond Alkali Co.

work, design of major equipment and general layouts. Then after general approval by the operating department, an approximate estimate is made up and a request for appropriation is presented to management.
5. Upon approval of the appropriation, the engineering is completed, necessary material, equipment and services are requisitioned, and the project passes into the construction stage.
6. The construction engineer must concur in the approximate estimate, but after drawings and specifications are complete, he makes up his own firm estimate which may be revised from time to time as the construction proceeds.
7. Upon completion of the engineering on the project, the design engineer brings his design report up to date. This second issue includes drawing and requisition lists and detailed operating instructions. This issue serves as a guide to the operating

CONCLUSION

Naturally there are many projects whose progress through the department is much simpler than above outlined. For instance, one of the plants may send us a chewed up pump impeller with the request that our metallurgist recommend whether or not a change in design or materials can be expected to give better service.

This organization has functioned for several years handling projects in size ranging from the pump impeller inquiry mentioned to complete new plants and has been found to be sufficiently flexible to handle anything which we have been called upon to do, with reasonable efficiency.

. . . . by R. W. Chaffee

Consulting Engineer

Kenneth A. McIntyre Associates

Cleveland, Ohio

▲ WE have heard, in considerable detail, of the structures and operating policies of three prominent and successful organization units engaged in creative engineering, namely Diamond Alkali Co., Republic Steel Corp. and Jones & Laughlin Steel Corp. Each of these is different than the others in many ways. No one of these organization units could be duplicated exactly in another industry and their differences prove that no one of them could be duplicated in another enterprise in the same industry. If we are to profit from these papers, and glean information which we can put to good use in our respective organizations, we must analyze these engineering organizations and seek out the common thread or pattern of basic principle. Only after this pattern is clear can we adapt it to our several engineering units with any hope of success.

It is my purpose, here, to make such an analysis and to bring out the fundamental principles of engineering organization which these three papers confirm.

The senior supervision of creative engineering, in the persons of the chief engineer and his assistant, has two major responsibilities. One of these is to initiate, conduct and complete certain creative engineering projects related to the company's product and plant so as to perpetuate the company's capacity to compete in the market and its production facility. The second responsibility relates to the administration of the engineering organization and to continuity of engineering policy and standards. The first responsibility is obvious and generally accepted. The second responsibility has been recognized to a lesser degree. Our analysis, of three prominent and successful engineering departments will emphasize the need to distinguish between these major responsibilities and to accord to each its full share of recognition.

PROJECT TECHNOLOGY

Many companies engage in basic or pure engineering research which delves into fundamental industrial art. One example of this is the time-honored search for the phenomenon which makes grass green and preserve colors which are impervious to natural elements. While not shown on the attached chart of functions (Figure 1), it should be "read-in" as an offside or staff adjunct to project technology and without administrative connection with any other function of the engineering department. We see this research work as a staff responsibility in the Diamond Alkali Co. engineering department.

The major function, which, we call "Project Technology," as distinct from the management or administration of an engineering department, includes general supervision. Project engineer is his title in one of these organizations while the function is performed by the assistant chief engineer in the second engineering department. We find the same function in the office of a chief design engineer in the Diamond Alkali Co.

Under the general heading, project technology, we find the basic function of creative development which is defined as the actual original application of engineering knowledge, skill and training to invention. This function begins with outlining the approach to the solution to the problem, as distinct, from executing the project as is done by craftsmen and detailers and checkers.

We identify creative development with "assigned" projects and we distinguish this work from basic investigations, as hereinbefore described.

Under this heading of creative development, we find two types of technology. One is the general technology, which covers the entire scope of the project in all of its parts and all of the branches of engineering involved.

In the case of Republic Steel, creative development is conducted directly by the project engineer.

In the case of the Otis organization, a squad leader is assigned to supervise this creative development, while at the Diamond Alkali Co. we find the design engineers performing that function.

We distinguish from general technology, the applied technology, which in one case is electrical engineering or civil engineering, and in another case squad leaders in charge of steel rolling or the steel product, or the limited application of technology to a specific branch of the business.

Applied technology in the Diamond Alkali organization is performed either by the staff engineers or by the design engineers, according to their specialty. The men are picked according to the thing they can do best and assigned according to their special skills.

Thus we see three engineering organizations which reflect a common pattern of structure and method. Let us explore this pattern further.

Project execution, as it appears here, is the carrying out of the solution as approached by creative development. We divide it between general technology and specialist technology.

As general technology, we have supervision, design, drafting, checking, writing of specifications, estimating, etc. All of these are found in three organization charts and are performed by people either designated solely for those jobs or as parts of other jobs.

In the same group, we have specialist technology, such as the squad leaders whose work confines them to electrical work, to structural, piping, mechanical, track and the other specialties which Mr. Monks described.

The fifth major function of project technology relates to construction. Seldom does an engineering department itself engage in construction, but frequently it must supervise, or counsel with and guide actual construction, whether that construction is performed by another branch of the same company or by an outside contractor.

Now we leave project technology, go over to another parallel chain of functions under the general heading of engineering administration.

We have seen three people in these three organizations performing, in some degree, the function of engineering administration. In the Republic Steel group, we

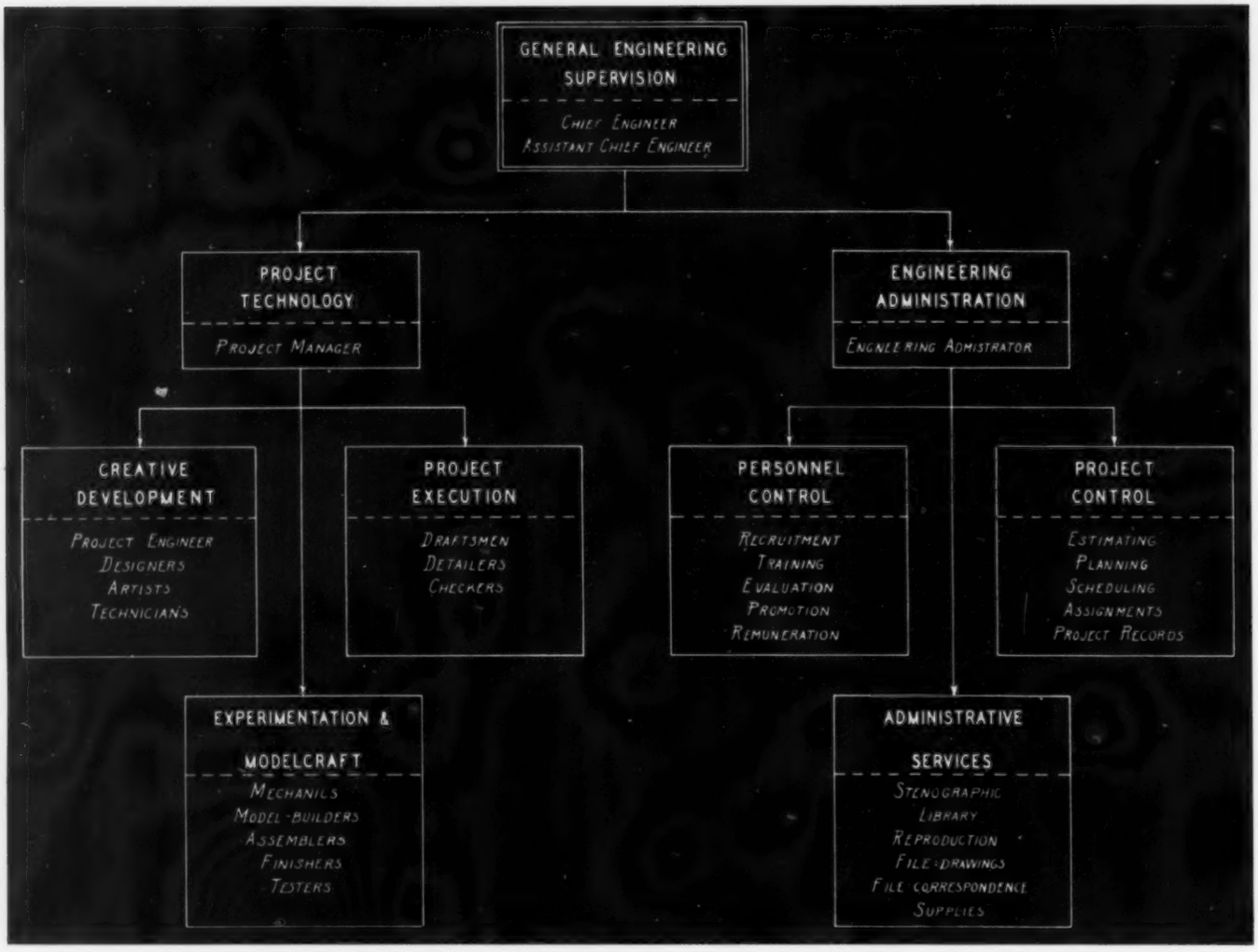


Figure 1 — Functions of an engineering organization.

have an office engineer. In the Otis group, a general clerk, and in the Diamond Alkali Co., a chief clerk.

A function of engineering only now coming to the front, but being recognized increasingly is that of personnel control, in relation particularly to engineering personnel. This function in an engineering department takes care of recruiting, placement, training, evaluation, status, remuneration and related aspects.

Traditionally, this work has been done by the personnel department of the whole enterprise, for the sales department, for the manufacturing department, for the engineering department, and for all departments. However, there is a growing conviction that an engineering department is a little better able to do its personnel job, to do it at the right time, and to do it more intelligently than some remote personnel department. We should look forward to a continued growth of this practice.

The next major function is project control, which we have found in these three organization charts. The supervision in Republic Steel is called a chief clerk and in Diamond Alkali Co., an office supervisor or assistant office supervisor. Under this heading we include procurement of materials or contract labor, keeping the cost records and the follow-up of cost experience, the expediting of materials and contracts, the maintaining of labor records, and various miscellaneous jobs which are administrative in character and must be done in the engineering department.

Finally, we must provide for the miscellaneous administrative services which include the stenographers, reproduction of blueprints and photostats, files of blueprints, correspondence and reports, the technical library, technical report writing and the maintaining of engineering supplies.

CORRELATION OF ENGINEERING FUNCTIONS

Figure 1 illustrates these functions and their correlation. This chart was designed for a different purpose, and I will ask, that you read into it certain changes.

At the top we have the General Engineering Supervision, consisting of the chief engineer and the assistant chief engineer.

Not shown here, but belonging in a block off to the side is the staff capacity of general investigations or engineering research which I have spoken of, which is not identified with either project technology or project administration and which is usually conducted under the chief engineer's supervision.

Immediately below the general engineering super-

vision we would have the detached engineering organization where it occurs, in the capacity of the resident plant engineer, as described by Mr. Monks, and the balance of the chart would then become the chart of the detached engineering organization.

On the left appears the functional group headed up by project technology, as I described, separate from engineering administration. This distinction emphasizes the point made by two of our previous speakers, that it is well to have the engineering administration group relieve the creative technical people of the burden of administrative details, and to give the very important administrative work the attention it deserves.

This chart was aimed at product development which would employ artists and certain technicians not required in the iron and steel industries.

Also we see here the function of project execution as carried on by draftsmen, detailers and checkers.

Instead of "Experimentation & Model Craft" as it appears here, I ask that you read "Construction," either by supervision or liaison in the manner which best fits the individual enterprise.

On the right, we have Engineering Administration, with separate supervision, with Personnel Control, and Project Control. Both functions are important and require different abilities to carry them out. The miscellaneous administrative services appear in this group of major functions.

That, very briefly, is my effort to develop the basic organization pattern for the effective engineering organization. Whatever its variations in the individual enterprises, this pattern may be seen in a great many engineering organizations.

DISCUSSION

PRESENTED BY

F. M. DARNER, Chief Engineer, Manufacturing Divisions, Republic Steel Corp., Cleveland, Ohio

C. A. BUTLER, Director of Engineering, Diamond Alkali Co., Cleveland, Ohio

F. E. ROBINSON, Assistant Division Engineer, American Steel & Wire Co., Cleveland, Ohio

GEORGE S. MONKS, Chief Engineer, Otis Works, Jones & Laughlin Steel Corp. (Retired)

R. W. CHAFFEE, Consulting Engineer, Kenneth A. McIntyre Associates, Cleveland, Ohio

LEONARD LARSON, Chief Engineer, Corrigan McKinney Plant, Republic Steel Corp., Cleveland, Ohio

CECIL FARROW, Project Engineer, Republic Steel Corp., Steel & Tubes Division, Cleveland, Ohio

C. CLARKE WALES, Chief Project Engineer, National Tube Co., Lorain, Ohio

F. M. Darner: Mr. Butler, I noticed in the discussion of your paper that your construction engineers prepare your construction estimates. Could you elaborate on that? That seems a little unusual. Usually the departments have estimators. Will you tell us why you do that?

C. A. Butler: The reason is rather basic. Heavy equipment is usually fairly easy to estimate. The items which are hardest to estimate are field labor and miscellaneous construction overhead. A designer with only limited field experience usually estimates that on a job there will be a couple of cranes around and that about 5 per cent ought to cover the construction overhead. Anyone who has had anything to do with field costs, especially in these days, knows that this is a fallacy.

Another type of item that is hard to estimate without actual field experience is illustrated by a small pipe run that probably does not cost more than $30 for material, but must be installed in an inaccessible location where it may cost $300 for scaffolding for the pipefitters.

So it has been our experience that a man has to have actual and recent field experience in order to be a good estimator. Our men who are doing estimating know that they are not going to prepare their estimates from a desk for very long. They have been warned that they are going to have to actually run a field job periodically, probably at least every three years, so that they can keep their hands in on estimating these items which are practically impossible to estimate intelligently without recent and up to date field experience. I have been a construction supervisor myself, and I find that I am out of date in my impressions and information because I have not actually run a job in the field for a number of years.

Summarizing my answer to your question, Mr. Darner, there are two basic reasons why our construction engineers prepare our estimates.

First, a man needs actual field experience in his background in order to estimate the items that are the hardest to estimate.

Second, since he has to go into the field periodically in order to keep up to date on his knowledge, he might as well be running the job while he is getting this education. After all, we cannot give him a postgraduate course every three years without getting some work out of him while he is getting himself re-educated.

F. E. Robinson: Each one of the authors has a different way of making estimates. Each one thinks he is good. May I ask if they ever have overruns?

C. A. Butler: In my opinion, we could well devote an entire evening to the subject of estimating. But briefly, this is the way in which we try to get along with our management when estimates have to be changed.

In the first place, we have three classes of estimates. We have a preliminary estimate. We have an approximate estimate, which is usually as far as we have the opportunity to go by the time we ask for an authorization, and we have our firm estimates which are made after completion of drawings and specifications; and though sometimes the firm estimate is not completed much ahead of the completion of the job, it is still important.

A preliminary estimate sent out from the engineering department is a paper that has "preliminary" typed across it, cornerwise, so that everyone that sees this estimate certainly should know that it is preliminary. If our management approves a project on the basis of a preliminary estimate, they certainly give this approval with their eyes wide open to the fact that the approval is based on little more than an educated guess as to the cost of the project.

An approximate estimate is based on preliminary

engineering and is the best we can do prior to the completion of engineering. We feel that if we do not overrun a preliminary estimate once in a while, we are not doing our job properly because it is just as bad a mistake to consistently overestimate as it is to consistently underestimate. If our underruns come somewhere near balancing our overruns, we feel that we are doing a fairly good job.

A firm estimate is made in this way. As the drawings come off the board, the construction engineer takes off detailed quantities and man-hour estimates from them as a basis of the firm estimate. If this estimate exceeds the amount included for comparable items in the estimate on which approval of the project was based, we inform our management that the estimate is going to be exceeded, before the treasurer's department is in a position to tell us that the money appropriated is all gone even though the job is not yet finished. There is some psychology in this, but there is also the very practical aspect that we can keep our management informed more accurately regarding our construction cash requirements for the immediate future. At any rate, this system seems to suit our management, and is the way we keep from getting fired in spite of a certain number of bad estimates.

George S. Monks: May I add something to that subject? Overruns are a bugaboo. It is very embarrassing to come back with your hat in your hand and ask for more money, but it is a reasonable expectation in a good many cases.

There are various reasons for overruns. In the last few years no one could expect to estimate on current prices, and not come in for an overrun request before the job is completed. The rule in our case is to estimate on current prices.

Another cause for overrun is change in the ideas. Somebody brings in a bright idea and wants it done differently. There are other reasons besides that, the incompetence of the squad leader who forgets something, or the estimator under estimating.

But the management is fed up with this overrun question. They want to have financial control, so they want us to ask for money on a preliminary estimate. We get the preliminary estimate and they make up their minds generally as to whether the project is justified or not. Then we can ask for appropriation request, which is a detailed estimate.

If there are changes in the scope of the work or increases in prices, we are justified in coming in and asking for more money. Otherwise, without any changes in scope, we ought to be able to do it for the amount of money we request.

F. E. Robinson: At what stage do you make your appropriation estimate?

C. A. Butler: We try to get as far with the engineering as we can before requesting an appropriation, but usually the appropriation request is based on an approximate estimate. We in the engineering department do not like to request approval based on a preliminary estimate, but there are sometimes jobs when management says, "Okay, we do not have time for delaying this decision, so if this is your best guess, we will approve the project on this basis."

In our company we are quite fortunate in that we have a general understanding that an approval is to do a certain job, and is not just a check for a specified amount of money. Of course, before approving a project, management must have the best available information as to how much it will cost. We do not have to get reapproval unless there is a change in the scope of the project.

We present a supplementary appropriation request on a project when the firm estimate shows that the actual cost is going to go over, or under, the original estimate. We will reduce an appropriation just as quickly as we will ask for an increase, because an unexpended balance in an appropriation is always an invitation for unnecessary trimmings on the project.

In our supplements we explain the difference between original and up to date estimates on the basis of four or five points.

First, is the change in general price level. This used to bother us a lot, but has not been causing us so much trouble in recent months.

Second, is change in design, which takes care of a situation where, as has been said, "Somebody dreamed up a way to do the same thing better."

Third is change in scope. As an illustration, our estimates might have been based on turning out 100 tons per day of a product and after the job is started, somebody says, "Well, while we are doing it, we might as well have a little bit of provision for growth, so let us make it 130 tons per day." Or somebody might say, "While we are doing this job, let us fix up this mess which is right next door which has needed fixing for the past ten or fifteen years."

F. E. Robinson: Do you have to get approval from management to make those changes in scope?

C. A. Butler: Changes in scope have to be approved. But our company is not so large that we cannot do a little corner-cutting and get such approval rather shortly when the occasion demands.

The engineering department has a reasonably free hand so far as changes in design are concerned. But internally in the department every change in design has to be justified economically. The principle is to start out with the simplest installation, and the additional cost of any elaboration over this simplest installation has to be justified by the savings made by the additional investment.

George S. Monks: We try to have a man as an estimator who has had a good many years' experience as an estimator. All construction work that he estimates must have the approval of the construction engineer. The projects are reviewed with the construction engineer, so before the estimate goes in for appropriation, the construction engineer's signature must be obtained. In that way we try to give the construction man the opportunity to see if there is money in the estimate for the work that he has to do.

R. W. Chaffee: It seems to me that this estimating for construction cannot be reduced to formula but is best done by the construction man because of his experience. However, a formula which provides an independent check on construction cost is frequently helpful.

Leonard Larson: It is our practice, or our thinking, to use past experience to guide in evaluating successive jobs. We are thinking in terms—although right to date I do not believe we have made very much progress in

that direction, of charting the experience on each job to evaluate trends, such as classifying certain typical types of work. We encourage the estimator talking to the field engineer, reviewing the job as the estimates are being prepared.

F. M. Darner: Mr. Monks, you did not follow an engineering project through your engineering organization, as Mr. Butler and Mr. Larson did. Would you mind telling us how your organization functions on the job. Can you give us an example?

G. S. Monks: The projects coming into the engineering department vary in their magnitude and importance. Let us select one major project and see how it is.

Somebody has an idea, and it has grown up over a period of years, "that the product is not what it ought to be for certain reasons." That has been discussed and discussed, and finally management makes up its mind that some action should be taken. A meeting is called by the general superintendent, to which somebody from the maintenance department, engineering department, operating department, all are present. The project is outlined, and the engineering department is asked to develop something on this. The resident engineer takes this in hand and one of his squad leaders makes a tentative proposal, or sketch, maybe a rough estimate. This then, when it is ready, is a subject of discussion in another meeting. Variations from that original thought are brought into the picture and he goes back and does it over again, maybe several times, until something tangible, that everybody agrees on, is developed. The resident engineer then revises the estimate and the drawings. It is then submitted to the industrial engineers for study and justification of the project.

This preliminary report then is sent in to the management and to the chief engineer, where it is discussed and they decide whether the project is justifiable and whether they have the money for it. They then give their authority for us to proceed to prepare an appropriation request. The resident engineer then instructs a squad leader to "Go ahead and develop the engineering to the point where you know all the equipment and services, materials, that go into this project." That does not mean every pipe and valve and fitting, but that does mean that he has to be covered with an amount of money that will represent the final cost of the project.

He prepares that appropriation request, the estimator doing the detail estimating. All the operating, maintenance, engineering, personnel that are required, anybody in the organization that is available and on call and their opinions and their expert help can be obtained in every way asked for. That appropriation request is sent in and acted upon by the appropriation committee and by the board of directors. Then it becomes a detail project. This same squad leader who handled it in the preliminary stages follows through, supervises the detail engineering, the making of the drawings, and beyond that it is out of our hands.

F. M. Darner: Mr. Larson, I noted on your chart the blueprint and filing people under your chief draftsman, while your office engineer had charge of scheduling orders, stenographic work, and office detail. Would you mind elaborating on this section of the department.

Leonard Larson: There is no good reason. It so happens that the department is surrounded by the drawing room and is used to a great extent by all the drafting room personnel in getting file reference prints in and out of the department, whereas the office engineer calls for prints that go out with orders, usually those are checked by the drawing room before it leaves for that purpose. There is no good reason why it could not be done the other way. It is a habit that has grown out of precedence.

Member: How about overruns on appropriations?

F. M. Darner: Overruns are usually inversely proportional to the amount of time the engineering department has had to prepare its studies and estimates. We have also learned that the elapsed time between the beginning and completion of a project may have considerable affect on the final cost due to further study by operating personnel who are prone to change their thinking. If you are not careful they will insidiously change the scope.

Leonard Larson: I have had occasion several times in backtracking overruns or erratic estimates, and have checked them over a long period, as much as a year over a multiplicity of jobs, and I have found in almost every case that the overrun or underrun, in the aggregate, is very nominal. It would be two or three per cent over or under, which has been surprising to me, but then there are always some sour notes. Those are the ones we hear about, and the 95 per cent that run true to the pattern are forgotten.

Those are the things we all have to worry about and find a way out.

F. M. Darner: The authors have spent a lot of time preparing their papers, whittling them down, so that we could present this in a comparatively short time. I think all of you men who have anything to do with supervision in engineering, or in fact, supervision of any department, realize that this is a very meager effort to scratch the surface of a big problem. It has many classifications, as to just how each one of these groups of people necessary to provide a complete organization can be developed so they will function in the highest capacity.

In general, management will welcome an improvement in the engineering system and organization. As supervisors, the job can be done by us better than by others. We want to encourage the men present to plan more of these meetings. I think we should develop the detail of a plant engineering organization, the drafting squad, the design engineers, and how best to do the office paper work and supervision. Some of our engineering departments do not have office supervisors that could arrange schedules of work better than they are at present. As an example, we know there are many high salaried engineers doing a lot of detail and clerical work that can be done better, or just as well, and cheaper by others. This is a point that should be corrected.

Furthermore, we ought to strive to get the engineering department so those who are most experienced in the departments can devote their entire energies to the solution of problems rather than to spending about one-half of their time on detail.

Just how to accomplish that, we do not have the solution. We encourage you men to discuss it, and I think the AISE should have several meetings on this

subject, taking up the various phases of the organization of an engineering department.

R. W. Chaffee: I might amplify the subject of estimating from the professional point of view, where close estimating of the engineering project is both critical and necessary.

Before a professional job is authorized, the client wants to know how much it is going to cost him, and when he will get the final results. We have to give him a realistic picture, which although not a binding contract, is nonetheless reasonably reliable. We must analyze the job carefully and attempt to forecast the probabilities and contingencies. We are selling man-hours of creative effort, the outcome of which no man can foretell fully. We do know that to make an 8½ by 11 drawing of one very simple piece takes an average of ten hours on the board, or we allow 15 hours for drafting an assembly of three or four pieces, and checking takes 25 per cent of drafting time. Beyond this, the forecasting for creative development is the product of experience and enlightened trial-and-error which, with the passage of time and with persistent effort, becomes more accurate and useful.

Every week we want to know the per cent of budget hours expended by each of the stages of the project, and we want from the project engineer a separate estimate of the percentage of completion of that stage.

Those two figures can be compared and if we have spent 50 per cent of our budget hours while the work is only 35 per cent completed, we are forewarned that we are going to overrun the budget. When this happens, we must either redirect our effort to stay within the budget balance, or seek an increase in the budget.

That is not accomplished overnight. I have spent many years getting this control into workable shape, but at least it is giving some promise and helping to solve the problem you have mentioned.

Cecil Farrow: I notice you have under Republic no detached organization listed. It seems to me that we have several somewhat detached engineering organizations in the Republic Steel.

Leonard Larson: These do not come under the jurisdiction of our particular department, and it is not intended to cover engineering in Republic as a whole.

Cecil Farrow: That is the impression I received, but I wondered whether it was made clear on the chart that you are talking about one of the detached engineering organizations rather than the corporation.

C. Clarke Wales: This subject has been very well presented by the various speakers in the time allotted to them. We have similar types of organizational set-ups as represented by Republic and Otis with the various plants of the company maintaining a chief engineer and complete engineering organization. Another organizational set-up is represented by Diamond Alkali, where a central engineering department is maintained at headquarters to take care of all engineering and construction work throughout the various plants of the company. Mr. Butler has mentioned that it is the practice of Diamond Alkali to have their engineers go to the field every two or three years to get field experience. This, of course, would seem more necessary in the central engineering type of organization as compared with the dispersed engineering departments at Republic and Otis, where their engineering departments are in the field in effect at all times and, therefore, are continuously closely associated with the actual construction work in the field and the problems of accounting for expenditures, which, in turn, makes it more practical for them to make the estimates on new work.

The discussion this evening with regard to estimating and the amount of jobs estimated in an engineering department in detail as compared with the actual projects approved is, indeed, a very important and interesting subject, as in most engineering departments far too much detail estimating and engineering work is done on projects under consideration, most of which are never authorized; in fact, many engineering departments in the steel industry spend 80 per cent of their time on this type of work and 20 per cent of their time on the engineering of work for which money is actually granted. These figures could be reversed by experienced engineering leadership and cooperation from management and plant supervision. Accurate accounting on construction programs is, indeed, the basis for accurate estimating. The problem of overruns and underruns and the attitude which should be adopted with regard to them is, indeed, an important one. Some deadline or top limitation must be placed on all projects and while I am sure it is generally realized that no estimate on a large project can be accurate within plus or minus 5 per cent in normal times even at the time the estimate is made. Where these projects extend over several years no one is prophet enough to guarantee that the overrun or underrun may be considerably greater than this. A number of interesting personnel charts for engineering organizations have been presented here, all of which seem to have considerable merit. These charts, of course, in actual practice are subject to variation within the experience of the chief engineer based on the personnel available to him and their special experience and ability.

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DEVELOPMENTS IN *the Use of* STAINLESS STEEL

By JOHN L. COTSWORTH
Atlas Steels, Ltd.
Welland, Ontario, Canada

. . . . stainless steel should not be looked upon by the steel industry as a material for the other fellow . . . . stainless is also valuable in steel plant applications . . . .

▲ IT HAS been said that the steel industry is unique from an organizational standpoint. In slack times, the operating department is a branch of the sales department. Conversely, in times like these, salesmen become operators and the sales dept. reports to third assistant helpers in the melt shop. The swing back and forth through the years of feast and famine has certainly been healthy for people in both kinds of jobs. It has brought operating and sales departments closer together to a better understanding of each other's problems.

Perhaps some of you have not thought about stainless steels in connection with your own mill problems. You have doubtless seen your equipment break up, wear out or burn out and simply set about repairing or replacing it with the same old materials, but just a bit heavier. Mere added weight is not always the answer to a breakdown. Did corrosion contribute to machine failure—not the ordinary type of rust corrosion that is plain to see—but the subtle forms of corrosion—galvanic action, pit corrosion, corrosion fatigue or high temperature deterioration? Why do pumps gall and drop off in efficiency? Why do steam valves leak? After five coats of paint on a 2-ounce galvanized roof, what sabotages the pickle house every year or two? What does all this cost in maintenance and replacement? It is estimated that corrosion costs U. S. industry $3,000,000 per year.

It is unfortunate that stainless steels have become commonly referred to as stainless steels. These alloys, which are basically iron with chromium in excess of about 11 per cent, should be known as heat and corrosion resisting steels. Their use is not primarily confined to shiny store fronts, cooking utensils, sinks, cutlery and auto trim. In fact, it has been the industrial markets that initiated and have continued to consume a large share of the stainless tonnage produced. Today, 60 per cent of Atlas' stainless production is to meet the demands of basic industries. Only 10 per cent is for consumer products. The balance is going into aircraft, dairy and food handling equipment. Reference to basic industry means chemical process plants, paper mills, oil refineries, steel mills, mines and the like. These are the industries that have found stainless justifies its higher initial cost. These are the "shirt sleeve" applications for material that does not have to be brightly polished to be useful. Stainless steels are now comprised of over thirty popular compositions or grades. (Actually many more are made for special purposes, but thirty will represent 95 per cent of all production.)

Although some original work in the effect of these alloying elements on iron had been done by Frenchman Berthier as far back as the 1800's and Guillet in the early 1900's, it is widely accepted that Harry Brearly, consulting metallurgist to Firth Vickers and John Brown in England, was the first to recognize their commercial possibilities in 1914. By the time Brearly was awarded a patent on an alloy composition similar to our present day Type 420 cutlery stainless, other developments were taking place. In America, a lower carbon alloy was being used for steam turbine blading while in Germany, Straus was developing the chrome-nickel austenitic grades which today constitute over 60 per cent of the total stainless production (over 75 per cent of sheet and plate).

It was not until 1935 that ingot and casting production of stainless steels in the U.S.A. reached the significant figure of 71,198 tons per year. Most of the sheet and all plates were No. 1, or hot rolled, annealed and pickled, produced on hand mills in small unit quantities. In spite of the steady increase in volume each year (during 1949 approximately 326,000 finished tons shipped in U.S.A. and about 60,000 tons in England), stainless steel is still a specialty product, not to be considered in the same field of manufacture or use as tonnage carbon steels. Whereas the per capita consumption of ordinary steel in Canada is about 570 pounds per year, in 1949 the figure for stainless was only 1½ pounds per capita and this was divided between many forms and grades. Other countries have advanced their use of stainless steels, for example the United States to 4½ pounds per capita last year, and it is said that the quality conscious Swedish consume about 10 pounds per capita per year. Growth of stainless use in Canada is expected to gain rapidly as fabrication and production equipment advances, particularly in the flat rolled forms. Nevertheless, stainless will likely continue to be a specialty, and not a prospect for the continuous carbon steel mills.

Is there a simple explanation for the remarkable corrosion and heat resisting qualities of stainless steels? Why is stainless steel stainless? Unfortunately, there is no single simple answer. Scientists do say, however, that "passivity," the proper technical term for stainlessness, occurs in ferrous alloys when chromium is present in excess of about eleven per cent. The degree of passivity is dependent upon the amount of chromium present, other elements particularly nickel and molybdenum, the condition of the alloy or its metallurgical history, cleanliness of surface and the temperature, and specific media to which it is exposed. Even more factors influence passivity, but to a minor degree.

Some explain that a tenacious, acid resistant, invisible or submicroscopic oxide film develops on the surface of stainless steel, which protects the underlying metal. Whether this is actually true or not is somewhat academic, the important fact is that this oxide or passive film forms in the slightest oxidizing media including the atmosphere, and is dissolved only by certain strong reducing acids such as hydrochloric acid. This means that stainless is not absolutely stainless under all corrosive conditions. Actually, it is fortunate this is so, otherwise there would be no combination of pickling acids which would remove the scale resulting from hot-working or heat-treating, an operation essential before cold-working or polishing can be done. However, the mere fact that stainless is difficult to pickle is strong testimony for its general all around corrosion resistance.

As the specialty steel mills were working out the many complex problems of melting, rolling and finishing the various types of stainless steels, the chemical engineer was busy testing it. About 1927 one of the U.S. producers received an order for 500 tons for nitric acid storage tanks and this was the first tonnage order placed. From then on there has been a steady rise, not all in large lots by any means (50 lb items are still the rule, not the exception), and it has been accompanied by the gradual evolution of new grades, better grades and improved treatments. You can now divide these grades into three major groups: (1) the chromium-hardenable types which are martensitic, (2) the chromium-non-hardenable types which are ferritic, and (3) the chromium-nickel types which are non-hardenable by heat-treatment and are normally austenitic. Trade names have been replaced by standardized AISI type numbers.

As a general rule, an increase in chromium content means an increase in resistance to corrosion and oxidation. Type 410, containing about 12 per cent chromium is likely to discolour superficially in an industrial atmosphere and will resist scaling up to only about 1200 F. This grade is used for steam valve trim (it hardens to 400 Brinell on oil quenching), and for pump shafting in the annealed condition (about 180 Brinell). Type 446 on the other hand contains 27 per cent chromium, will resist extremely corrosive conditions and will not scale appreciably at 2000 F. It is non-hardenable and is widely used for furnace parts, skid rails and combustion chambers subject to direct flame impingement from high sulphur fuels.

The group containing high nickel contents, i.e. over 7 per cent are by far the most popular. They offer greater corrosion resistance than the other two groups and present some amazing properties. Like Hatfield manganese steel these alloys of 18 per cent or more chromium and 7 per cent or more nickel are normally non-magnetic. They are extremely ductile (elongation —60 per cent), tough (Izod 100 ft-lb) retain their toughness and ductility at extremes in temperatures from —300 F to +1600 F, and to varying degrees, depending upon the grade and analysis, these chrome-nickel alloys work-harden more rapidly than any other commercial metal in use today. While this works against you when trying to shape or fabricate the material, the fast work-hardening rate means you can produce extremely strong (200,000 psi tensile strength), lightweight structures or sections without resorting to expensive heat-treatment and finishing processes. Because Type 304 stainless has such high resistance to notch impact, it is used in very special expansion valves involved in the low temperature liquefaction and distillation of gases such as oxygen, nitrogen, etc. It might interest you to know that liquid oxygen containers are being made of Type 304 stainless, and this grade materially assisted in the development of the enclosed tank car for bulk delivery of oxygen to steel mills. The tanks in these cars are suspended on 3-in. round Type 304 hanger rods. Corrosion resistance was not the prime factor. High impact and tensile strengths at the extremely low temperatures involved dictated the use of shock-resistant stainless for safety's sake alone, but there was still another advantage. The chrome-nickel stainless steels have only about 60 per cent of the heat conductivity of carbon steels. Therefore, in this application less heat was transmitted to the tank, thus keeping the temperature and pressure down.

It is not my intention to delve deeply into the metallurgical details of these stainless steels. I do want to emphasize the remarkable range of proved usefulness of the various stainless steels. Only a few years ago they were called the metals of 10,000 uses. Now, you could say 100,000 uses solely within the scope of industrial or "shirt sleeve" applications. Having just referred to a case involving 300 F below zero let us illustrate this point by citing a few examples at the other end of the scale in the field of high temperatures.

Carbon steels lose their usefulness at temperatures

over approximately 1000 F. From there on up to 1500 F, most of the popular stainless grades containing 16 to 18 per cent chromium perform quite well. Type 430 (17 per cent chrome-0 per cent nickel) has given good service in box annealing furnace parts operating at 1400-1500 F. The straight chrome grades do not have as much creep strength over 1000 F, as those that contain nickel, but they do have the advantage of a lower coefficient of thermal expansion and therefore have less tendency to warp. In repeated heating and cooling cycles the protective scale formed is less apt to crack and spall off due to the lower rate of contraction. On the other hand, the chrome-nickel grades are generally more oxidation resistant for the same chromium content particularly when a small addition of silicon is made. For use up to 1500 F, Type 302B containing 2 to 3 per cent silicon is highly recommended both for its hot strength and its ability to form a tenacious protective oxide coating on itself. Alloys used for gears in automotive poppet valves are quite similar. Bell type hoods used in both ferrous and non-ferrous heat-treating have been made for some years now from Type 430 and Type 302B heavy gage sheet and light plate. Under such conditions they give 10 to 100 times the service life of heavy cast iron or carbon steels.

What is used over 1500 F? Many severe cyclic heating and cooling conditions such as in automatic conveyor furnaces are too rough on the grades mentioned and the higher alloys must be used. Type 442 with 21 per cent chrome gives a good account of itself up to 1800 F and is widely used for domestic oil burner combustion chambers. Type 446 with 27 per cent chrome, containing no nickel, is good up to 2000 F. It does not offer much tensile strength at this temperature but it makes an excellent furnace rail to keep billets and slabs off the refractory floor. Both of these grades are subject to grain growth at elevated temperatures and therefore do not weld or form as readily as the grades containing nickel. In the form of bars, these high chrome grades are used as electrodes in salt bath furnaces and as skimmer bars in brass foundries.

When you are confronted with a service condition involving 1800 to 2000 F and relatively high stresses such as a muffle, hot gas exhaust system, salt bath fixtures, furnace roof supports and the like—Types 309, 310 or 330 should be used. The scaling characteristics of each are about alike but they are progressively better for thermal shock in proportion to the nickel contained. Type 309 contains 12 per cent nickel, Types 310—20 per cent and Type 330—35 per cent. Until comparatively few years ago, these three grades were not readily available in rolled forms. They were usually cast and thereby had their limitations. Today they are rolled into bar, sheet and plate and very satisfactory welded products are being offered. Fabrication is being carried on by many firms who formerly did the casting.

With the current nickel shortage, your best advice is to use only Type 309 where necessary over 1500 F and drop down to Type 304 and the straight chrome 400 series whenever possible. You might not get 100,000 hours out of your equipment, but you will stand a better chance of getting the equipment. At Atlas our maintenance department is right now trying to get one or the other of these heat-resisting grades in the form of poker bars for our gas producer.

Are you impressed by the wide diversity of uses for stainless so far mentioned? No doubt many of you here can cite other examples, but would you think of stainless steel for an electrical instrument panel? It sounds extravagant, but Type 302 is being used for its non-magnetic property to eliminate induced magnetic interference with the instruments.

Acid handling has not been mentioned. Here we wish to put in a word of caution. Stainless steel is resistant primarily to oxidizing acids. Most grades are fine for nitric in all concentrations, but be careful when working with sulphuric. In certain concentrations of sulphuric, Type 316 stainless is satisfactory. For example, we use it for intermittently used pickling racks for an 8 to 12 per cent sulphuric solution at about 120 F. For 20 to 40 per cent acid and boiling solutions there are more suitable alloys available. Do not use stainless at all for hydrochloric. For handling phosphoric acid, however, Type 316 is excellent, even Type 304 is satisfactory for storing 85 per cent cold acid or warm 5 per cent acid. Strong alkali solutions are generally no problem, but in all uses involving severe corrosion we recommend you consult the literature available or conduct actual tests.

Throughout the chemical industry, stainless today is a must and the reason is not always because it resists corrosion. In many processes it is merely to prevent contamination of products being processed; such products are often worth more than the equipment used for processing.

In any industry, the value of using better, more durable equipment lies not only in reduced direct maintenance cost but in the minimization of non-productive shutdown time. If you stand to lose a thousand dollars a day when shut down, is it not more sensible to make sure your equipment is rugged and of the best materials? When you stop to consider the small part materials are of the total cost of most installed equipment, you realize that the higher per pound cost of stainless steel should seldom deter its use.

Do not look upon stainless steels only as that bright stuff in the kitchen, but a real group of "shirt sleeve" alloys capable of saving operators much money and headaches when properly used.

WANTED!

There is a constant demand for copies of "The Modern Strip Mill", published by the Association of Iron and Steel Engineers. If your copy is not in use please get in touch with us.

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Application of Precast Insulation to

WATER-COOLED SUPPORTS IN UNDERFIRED FURNACES

By JAMES E. HOVIS
Bloom Engineering Co., Inc.
Pittsburgh, Pa.

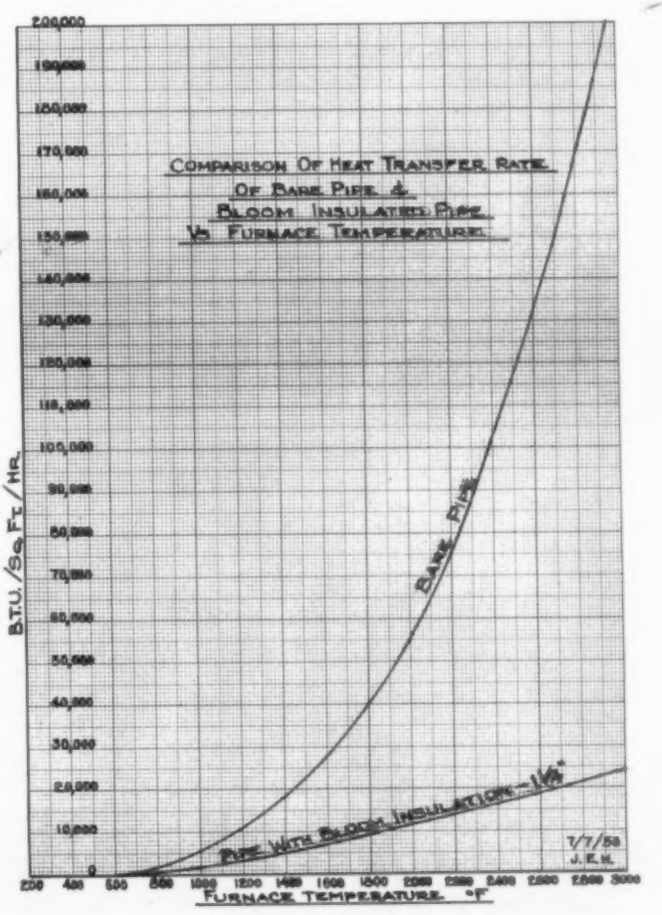
. . . . precast insulation can result in fuel savings up to twenty per cent and increase production as much as ten per cent . . . .

▲ HEAT loss to water-cooled support pipes in underfired furnaces, coupled with the effect of these cold surfaces located in close proximity to hot steel, gives rise to several serious problems. Specifically, these problems include:

1. Loss in efficiency. The quantity of fuel which must be supplied to overcome the cooling water loss represents a substantial percentage of the fuel input. This percentage in many cases will be as high as 25 per cent.
2. Loss in production. Furnace capacity may be limited by fan, stack, or burner capacity. If such be the case, furnace capacity is reduced since fuel, which otherwise would provide heat to the steel, must be supplied to overcome water loss.
3. Non-uniform heating. If burner capacity or combustion volume in the bottom zone be insufficient to accommodate the amount of fuel required to overcome the cooling water loss and supply the necessary heat to the steel, it will be impossible to maintain bottom zone furnace temperature. The heat transfer rate through the bottom surface of the steel will be substantially less than through the top surface and the bottom will be cold. The seriousness of this condition is a function of the thickness of the steel. On relatively thick stock, the difference in temperature between the top and bottom of the steel cannot be overcome if the furnace is to produce at a reasonable rate.
4. Slagging and sticking. Operators, when confronted with the problem of a cold bottom zone, tend to overfire the top zone in an effort to maintain required production rates. The usual result is overheating of the top surface to such an extent that considerable slagging and sticking occurs.
5. Due to the effect of cold skid pipes being in close relationship to hot steel, the sections which ride the skids are considerably colder. This condition is apparent, particularly in the case of relatively thick steel, even after normal soaking time. Also, during a mill delay, billets which lay immediately over a crossover will cool considerably such that a marked temperature difference will develop between these billets and those adjacent to them. This difference cannot be eliminated and in most cases these billets cannot be rolled.

The increase in skid and support pipe surface temper-

Figure 1 — As shown by the curves, the use of insulation reduces the heat transfer rate very markedly.



ature and the consequent decrease in heat loss to the cooling water attained through the application of insulation substantially overcomes these problems.

The effectiveness of a comparatively thin layer of insulation is indicated by the following curves:

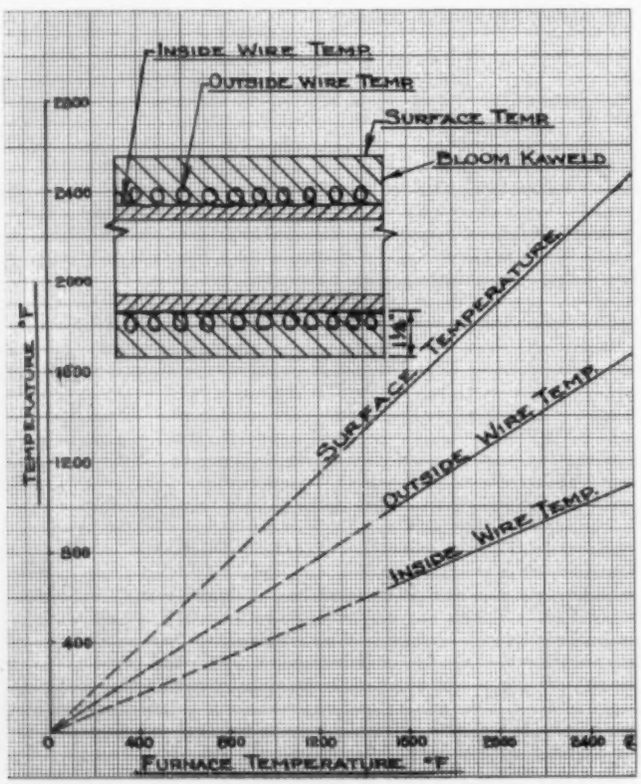
Figure 1 indicates a comparison between the heat loss to bare pipe and to pipe covered with insulation 1¼ in. thick. The horizontal scale represents furnace temperature, and the vertical scale, heat loss expressed in Btu per sq ft of pipe surface, per hour. Considering a furnace temperature of 2400 F, it is seen that the loss to bare pipe is 100,000 Btu per sq ft per hour, while the loss to insulated pipe is only 18,000 Btu per sq ft per hour. Thus a reduction in heat loss of some 80 per cent can be effected through the use of insulation 1¼ in. thick.

Figure 2 indicates the relationship between the surface temperature of 1¼ in. thick insulation and furnace temperature. The horizontal scale is again furnace temperature. At a furnace temperature of 2400 F, the surface temperature of the insulation is 2340 F, thus, localized cooling due to low support pipe surface temperature is almost entirely eliminated.

The following comparative analysis of the fuel requirements for a specific furnace operated with and without insulation will clearly indicate the advantages derived from the use of such insulation. The furnace as shown at the top of Figure 3 is designed to heat 75 tons per hour of 12 in. × 12 in. × 16 ft long blooms.

The furnace temperature curve would be approximately as shown for this particular design under conditions of continuous operation at the designed production rate.

Figure 2 — Curves give a comparison of the temperature at the various spots on the insulation illustrated by the sketch.



The surface temperature curve is assumed and the center temperature curve is calculated on the basis of this assumption. The location of the center temperature curve serves as a check on the assumption since the time lag between the center and surface temperatures is a known constant for a given material heated from two sides, except in the critical region, the initial phase of the heating, and the soaking period.

The average furnace temperature in the top and bottom zones proper, that is from 40 per cent travel to 78 per cent travel, is approximately 2350 F, and the average steel surface temperature through the same section of the furnace is 1925 F. The temperature of the gases leaving these zones is approximately 2150 F indicating an efficiency of 40 per cent. For the furnace under consideration, the area of exposed steel surface in the top or bottom zone is 480 sq ft, whereas the area of pipe surface is 235 sq ft.

The fuel requirements as approximated for these conditions, using the curve shown in Figure 1 to determine the cooling water loss, for the case of insulated supports and non-insulated supports are tabulated in the chart at the bottom of Figure 3. Considering the bottom zone, the heat to steel would be 15,800,000 Btu per hour in both cases. The water loss is 3,900,000 Btu per hours for insulated supports as compared to 21,300,000 Btu per hour for non-insulated supports, thus the fuel input required for the bottom zone is 50,000,000 Btu per hour for insulated supports as compared to 93,000,000 Btu per hour for non-insulated supports.

For the top zone, the heat to the steel is again 15,800,000 Btu per hour, so that the input required in both cases is 40,000,000 Btu per hour.

The required input for the soaking zone is approximately 25,000,000 Btu per hour. Hence, the total fuel required in the case of insulated supports is only 115,000,000 Btu per hour, while that required for non-insulated supports is 158,000,000 Btu per hour. The approximated fuel savings realized with the insulation is therefore 27 per cent. The average saving experienced on installations comparable to that under consideration is approximately 20 per cent based on monthly figures.

Present design practice would indicate fuel capacities on this particular furnace approximately as follows:

Top Zone—70,000,000 Btu per hour.

Bottom Zone—70,000,000 Btu per hour.

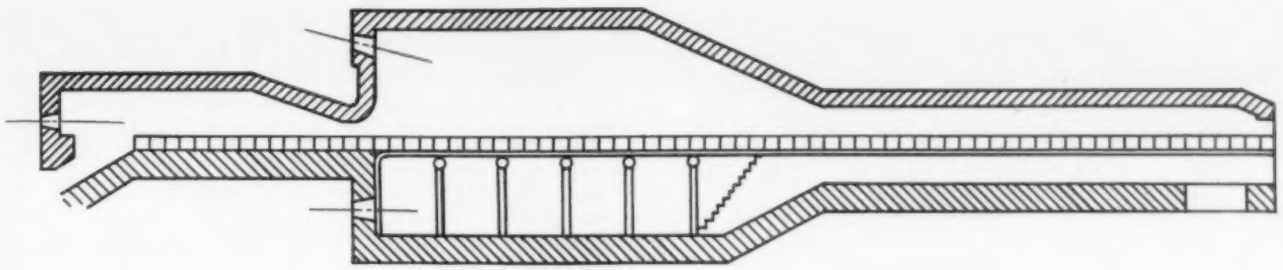
Soaking Zone—30,000,000 Btu per hour.

However, the required fuel input for the bottom zone is 93,000,000 Btu per hour with non-insulated supports. Since the fuel capacity is insufficient, the furnace temperature must be correspondingly lower such that a heat balance is maintained between input, heat to steel, and losses. This balance would occur at a furnace temperature of approximately 2200 F, and the bottom surface temperature of the steel would be only 2050 to 2100 F as the bloom enters the soaking zone.

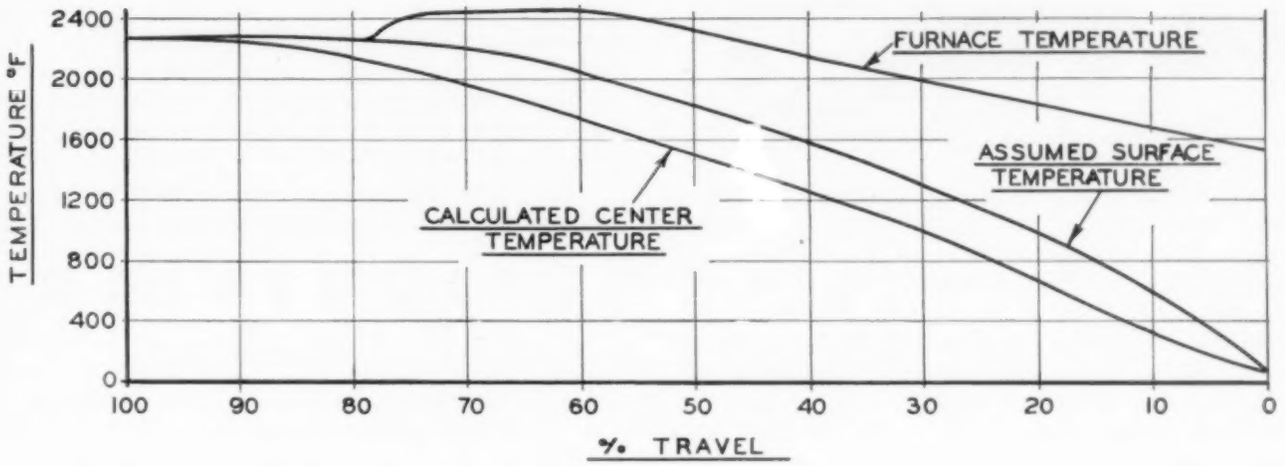
Here lies the reason for the non-uniform heating, slagging, and sticking difficulties.

Realizing the importance of insulation from the standpoint of overall furnace performance, we come to the problem of applying such insulation. The design and method of application must meet the following criteria:

1. The time required for installation must be held to a minimum.



TEMPERATURE VS TRAVEL
PRODUCTION RATE - 75 TONS / HOUR
MATERIAL 12"x12"x16' LONG BLOOMS



ESTIMATED COMPARITIVE PERFORMANCE
INSULATED SUPPORTS VS NON-INSULATED SUPPORTS

AVERAGE FURNACE TEMPERATURE - 2350° F
AVERAGE STEEL SURFACE TEMPERATURE - 1925° F
TEMPERATURE OF GASES LEAVING BOTTOM ZONE - 2150° F
EXPECTED EFFICIENCY BASED ON GASES AT 2150° F - 40 %

	I INSULATED SUPPORTS	II NON-INSULATED SUPPORTS
HEAT TO STEEL - BTU/HOUR - BOTTOM ZONE	15,800,000	15,800,000
HEAT TO COOLING WATER - BTU/HOUR	3,900,000	21,300,000
FUEL INPUT REQUIRED - BTU/HOUR @ 40 % EFFICIENCY	50,000,000	93,000,000
HEAT TO STEEL - BTU/HOUR - TOP ZONE	15,800,000	15,800,000
FUEL INPUT REQUIRED - BTU/HOUR @ 40 % EFFICIENCY	40,000,000	40,000,000
FUEL INPUT - BTU/HOUR - SOAKING ZONE	25,000,000	25,000,000
TOTAL FUEL REQUIRED - BTU/HOUR	115,000,000	158,000,000

CALCULATED % SAVING WITH INSULATION - 27 %

Figure 3 — The use of insulation results in appreciable fuel saving as indicated by the calculations in this illustration.

2. The insulation must be of ample mechanical strength to withstand normal service conditions.
3. The insulation must be resistant to thermal shock.
4. The insulation must be capable of withstanding the elevated temperatures to which it is subjected.
5. The insulation must be resistant to slag and scale at elevated temperature.

A precast insulation such as the one shown in Figure 4 essentially fulfills these requirements.

The precast half section is formed by embedding heat resistant alloy wire mesh into a high temperature castable refractory. The alloy wire performs two important functions—it gives strength and rigidity to the refractory, and it provides a simple, dependable means

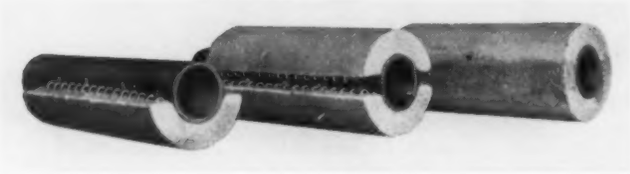
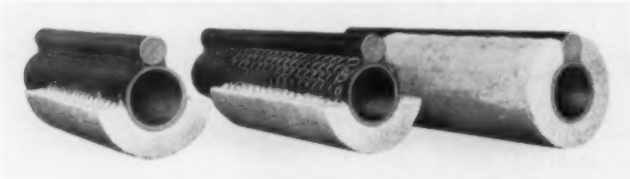


Figure 4 — The insulation is easily installed as shown by the illustration.

Figure 5 — Method of applying skid pipes is shown in the diagram.



of fastening the precast half section to the pipe. The ends of the wire extend beyond the refractory so that they are readily tack-welded in place. The temperature of the alloy wire in a furnace at 2600 F is 1825 F which is well below the allowable temperature. The refractory used will withstand temperatures up to 3000 F and due to an extremely low expansion factor will resist thermal shock. Precast half sections are provided in workable weights and lengths, and the sections can be easily cut with a standard refractory saw for an exact fit.

The method of application is as shown in Figure 4. The precast lower half section is applied to the pipe and the exposed ends of the reinforcing wire welded to the pipe. Similarly, the upper half section is applied and welded. The space between the two halves is filled with castable refractory, completing the installation. The method used for skid pipes is as shown in Figure 5. The lower half section of insulation is applied exactly as for the risers or crossovers. Heat resisting alloy reinforcing wire is welded on both sides of the pipe in the area between the wearing strip and the lower half section. Castable refractory applied to these sections penetrates into the coils of the reinforcing wire and covers the outer surface, thus providing a uniform protection of refractory insulation.

The installation time required for the furnace considered previously is approximately 1½ to 2 turns.

Typical of most new designs, a problem has been encountered under conditions of extreme service which was not fully anticipated at the outset.

Extremely high operating temperatures are encountered on high production furnaces such as those feeding the modern strip mills. Considerable slagging of the steel is evident. This slagging is due, in part, to overheating of the surface under normal continuous operation, and in part, to failure by the heater to immediately reduce furnace temperature when a mill delay occurs.

The deterioration which takes place when molten slag contacts a high temperature refractory surface is well known. Refractories which are highly resistant to slagging action are usually of low resistance to thermal shock. The ideal refractory for this type of service would be one which is highly resistant to slag and thermal shock and is also economically feasible.

The decreased service life caused by the above condition, although undesirable, is greatly outweighed by the advantages inherent in the use of insulation.

On the average heating furnace the picture is much brighter. One installation, comparable to the one analyzed previously, has been in service over a year. No serious deterioration is evident and the results are certainly gratifying.

One point which cannot be over-emphasized is the importance of maintenance. The advantages inherent in the use of insulation can only be fully realized if such insulation is properly maintained. The required repairs can be carried on simultaneously with other maintenance work during normal shutdown periods.

In summary, it need only be stated that precast insulation can mean up to 20 per cent overall fuel saving, 10 per cent increased production and a solution to the non-uniform heating, slagging, sticking, and skid mark problems—all of this at only a fraction of the capital investment required to accomplish any one of the above improvements by other known means.

DISCUSSION

PRESENTED BY

D. R. BAKER, Combustion Engineer, Timken Roller Bearing Co., Canton, Ohio

J. E. HOVIS, Bloom Engineering Co., Inc., Pittsburgh, Pa.

D. R. Baker: There is another advantage we have found with insulated support pipes and skids, and that is improvement in the water problem. Water is limited both in quantity and quality at our plant, and we noticed a great improvement as far as corrosion to the interior of the pipes is concerned by the use of insulation.

We had occasion to damage one of the skids by a broken bloom, and where the insulation was knocked off, there was a lot more deposit of lime scale in this pipe. We do have water treatment at our plant, which is sodium metaphosphate and even then, there is still a lot of lime that drops out in hot pipe. We feel by reduction of the surface temperature on the inside of the pipe, there is a great reduction in the amount of scale formation.

I would like to add a little bit on the fuel savings. We started out originally without insulation on the skids themselves, just on the supporting pipe. Then more recently, we installed insulation on the skids themselves, and we noticed an appreciable reduction in fuel just by the insulation of the skids.

There is one question I might ask. Is there any drying time required for this type of insulation on precast insulation over the ordinary insulation where you tamp on in the wet condition?

James E. Hovis: In the method used at present, the insulation is air-set at the factory. Thus, it is delivered to the plant in a form which requires no further conditioning. The furnace may be heated up in the normal manner without delay upon completion of the installation.

LUBRICATION OF ENCLOSED GEARS SUBJECT

to Chronic Water Conditions

By JOSEPH A. RIGBY
Vice President
The Brooks Oil Co.
Pittsburgh, Pa.

. . . . specially compounded lubricant is particularly effective in resisting effects of water contamination . . . .

▲ IN THE steel industry there are problems in rolling of plate, sheet, strip and other products where large volumes of water are used in cooling and descaling. Because of the flooding over the products being rolled, and the extremely high pressures in the case of descaling, the question of control and removal of water without damage to the mill equipment has challenged those responsible for design and the operating and maintenance groups.

Affected by these conditions are the table roller gears, table roller reduction gear drives, broadside turntable drives and other mechanism of the mills. Extreme care is exercised in design to provide the best in seals for roller and other shaft journals. Deflectors are provided and other methods are used to prevent water entering the lubrication systems for the gear drives. With new equipment, the initial results are usually good, but as seals wear from contaminating scale, dirty water, bending of rollers, vibration and shock conditions, water usually enters the lubricating systems. When purification systems are provided, these are of the circulating type removing water by demulsifying tanks, in some cases using two tanks, one for service while the other is removing water.

Many mills have nothing but a reservoir in each gear case or housing in which the gears dip for lubrication. An extreme pressure fluid lubricant has usually been used, but for needed protection against gear wear, ep lubricants should always be used. Water entering the batch contaminates the lubricant so the problem demands a lubricant which will repell water and a method for removal of excess water. Otherwise, the lubricant will be floated out of the gear case as a loss.

Lead compounded lubricants have proven to be logical and superior because of extreme pressure film characteristics, and because they repell water, are negative from a corrosion standpoint. They also can be used in light viscosities for quick and easy separation from water at ambient temperatures.

A method of water removal which is used satisfactorily uses a water leg or syphon made up of pipe and fittings with an adjustment vertically for height of overflow. This is attached to the side of the gear case or housing with regulation of the overflow level to a point which permits the gears to dip into the lubricant for sufficient coverage. The difference in specific gravities, with the lubricant on the lighter side, permits the lubricant to float on the top of the water with an arbitrary depth determined by experiment and regulated by the water leg. A low viscosity, high film strength fluid should be used to get rapid separation of the water and settlement of the water to the bottom.

With this method, loss of lubricant may be somewhat excessive, particularly so from the pumping action of the gears when running one direction for any length of time. Baffling has been used, but not effectively to prevent too much rise in the lubricant and to prevent leakage through the seals at one end from the pumping or agitating action.

Recently developed and being extended in use are solvent cut-back specialty lubricants of base material, compounded for extremely high film strength, unusual adhesiveness, water repellence, corrosion protection and air hardening action in leakage through seals or joints. These offer and have proven to be a solution to severe problems. Water legs or syphons are not used, as these lubricants are slightly higher in specific gravity than water so settle to the bottom. The unusual character-

istic of a sticky nature forms adherence to the gear case or housing and prevents water mixture in the reservoir.

In the method described, the water remains on top and can be floated out with an established regulating opening. Due to the rotation of the gears and entrance of water, a water and lubricant mixture is present, however, the sticky nature of the lubricant results in such adhesion to the gears that the lubricant is not affected by water. During tooth contact, the water is squeezed out and a continual replacement film of lubricant is applied to the teeth. With or without baffles, the adhesiveness of this type of lubricant prevents the objectionable pumping action and reduces lubricant losses to a negligible amount.

At points of leakage through horizontal and vertical joints, bearing or journal seals and possibly other openings, the solvent compounding develops an air hardening performance which constantly results in the formation of a gasket or seal. This characteristic can be and has been effective in leakage elimination and in creation of clean plant conditions.

An example of performance of this rather revolutionary lubricant, is the application in a continuous mill having eleven tables where cooling and descaling water is a serious problem. Various lubricants had been used with final adoption of a 2300 S.S.U. viscosity at 100 F, extreme pressure compound. Even with this lubricant, the corrosion and wear of gears was such that the replacement of table lineshafts and drive reduction gears averaged one per month, lubricant consumption was of staggering quantity, there were frequent mill delays and a messy floor and mill condition due to lubricant leakage.

A change to the solvent cut-back leaded compound having the inherent characteristics previously described, and with the same water conditions, has produced remarkable results in performance and savings. With two years of service, it has not been necessary to change any lineshafts or drive reduction gears, even though some gears were considerably worn when the lubricant was changed. The lubricant consumption has been reduced to one-tenth the previous quantity, leakage completely stopped, clean-up labor eliminated, delays are no longer a factor and general maintenance costs have been reduced to a negligible figure. Throughout a year of weather changes, the same grade of lubricant serves without thinning out or heat application.

Other similar conditions have been corrected and a field exists for consideration of such practice not only in the rolling of plate, sheet, and strip steel, but for other steel plant equipment; and in other heavy manufacturing industries such as the paper industry, which is subject to water contamination of lubricants where circulating systems are ineffective or not available.

As guidance in the selection of the correct lubricant, the matter of film testing can be helpful and an unusual test is now available. This is now in use and widely accepted. It is the "4 Gram Test" using a Timken Testing Machine. It is known to be the most exacting and severe that can be made to a lubricant. This test uses four grams only of the lubricant to be tested. This amount is just enough to cover the periphery of the cup or race and one surface of the block. The machine is brought up to speed, and the desired weights added to the lever arm with no addition of the lubricant for the duration of the test. Most high grade lubricants fail within five minutes, some run ten minutes and a few as long as twenty minutes with 43 pounds on the lever arm. The consistent and constant results in tests of lead compounded solvent cut-back lubricants with base material compounding for extremely high film strength is shown by the results—a duration of thirty minutes minimum with 43 pounds lever arm load. This favorably compares to 50,000 psi by the regular or standard Timken machine test with continuous circulation of the lubricant under test.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC. OF

IRON AND STEEL ENGINEER

(Required by the Acts of Congress of August 24, 1912, March 3, 1933 and July 2, 1946)

Name of Publication: *Iron and Steel Engineer*, published monthly at Pittsburgh, Pennsylvania. (Report of October 1, 1951.)

State of Pennsylvania
County of Allegheny

Before me, a notary public in and for the State and county aforesaid, personally appeared T. J. Ess, who, having been duly sworn according to law, deposes and says that he is the editor of the *Iron and Steel Engineer* and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Acts of March 3, 1933 and July 2, 1946, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher: Association of Iron and Steel Engineers, 1010 Empire Building, Pittsburgh, Pennsylvania.
Editor: T. J. Ess, 1010 Empire Building, Pittsburgh, Pennsylvania.
Managing Editor: None.
Business Manager: None.

2. That the owner is: Association of Iron and Steel Engineers, 1010 Empire Building, Pittsburgh, Pennsylvania.

No stockholders.

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T. J. ESS, Editor.

Sworn to and subscribed before me this 24th day of September, 1951.

G. WILLIAM JONES, JR., Notary Public

(My commission expires February 9, 1955.)

OIL-HYDRAULIC EQUIPMENT

By E. A. BERGLUND
Vice President
Hydraulic Equipment Co.
Cleveland, Ohio

. . . . oil-hydraulic equipment is widely used throughout the steel plant . . . .

▲ THE application of oil-hydraulic equipment is a subject that should be of a great deal of interest to persons engaged in most branches of engineering and is a subject which is also intriguing enough to be of interest to the average individual that has an inquiring mind. The know-how of water hydraulics is one that is very ancient and was in use back in the days of the Roman Empire and possibly prior to that time if one is to believe the historians. Yet, while modern hydraulics as they are employed today have the same basic principles, the question arises if the name "hydraulics" which is still retained as a general term, should not be revised and a new name, which has not been coined as yet, be given to "oil-hydraulics" which is a major subdivision of hydraulics at the present time. The average engineering graduate of ten to twenty years ago and possibly some of more recent years, remembers that the hydraulics taught in the civil engineering classes pertained practically entirely to the flow of water over dams and weirs.

The hydraulics discussed here will deal entirely with oil as the liquid medium. One will find that this phase of engineering as now practiced has nearly all been developed within a period of the last twenty years. There was some development work done a long time before that, but oil-hydraulics really came into prominence within the past ten years, prodded and pushed into existence by the needs of the World War II war machine. It is easy to understand that this young giant is still in its swaddling clothes and while there are quite a number of prominent manufacturers engaged in producing the hydraulic equipment used these days, a review of their manufacturing history will show that there are very few of them that date beyond a twenty year period.

One sees these hydraulic mechanisms in daily use and possibly does not give a second thought as to how these simple principals can be applied in one's own designing work. Reference is made to such common usages as the dentist's chair, the barber's chair, the grease rack in the average garage or the hydraulic jack that lifts a car to change a tire. A great many of the elevators in public buildings are hydraulically operated. The fluid drives in automobiles are now the subject of everyday conversation. Almost every dump body seen in these days is hydraulically operated. To name a few more—bulldozers, power windlasses; power cranes; front end loading mechanism on tractors; artillery recoil mechanisms; landing gears and operational features of airplanes; airplane catapults on aircraft carriers; the control mechanisms for the turrets in army tanks; and an endless group of other equipment with which one is in daily contact, but possibly never thinks of as being hydraulically operated.

A natural question arises at this point—why are all these mechanisms operated by hydraulics rather than by some mechanical or electrical means? The answer is relatively simple. The very common usage today of oil hydraulic equipment is due to the fact that, when it is properly designed and constructed, a hydraulic system possesses a number of very favorable characteristics that make it more desirable to use than other available means. Although many complex installations have been developed and are in everyday use for special purposes, the hydraulic systems in common usage are generally simple in construction and are really no more mysterious than any mechanical set-up if the trouble is taken to understand them. They eliminate or supplement gear trains, cams, levers and other mechanical apparatus. The component parts of a hydraulic system can be conveniently located at widely separated points and be positioned in almost any desirable plane while the inter-connecting parts which tie the system together can be readily and easily brought around corners and still leave the main power plant at some more convenient point. There are relatively small losses in efficiency in a system of this kind and no need for complicated mechanisms in most installations. By this means, very large forces which are confined in a very small space can be controlled and directed with ease through the medium of relatively small valves, piping, flexible tubing or flexible hoses. Protection against breakage can be provided by means of over-load relief valves, so that the system is safe against breakdown and strain.

Hydraulic systems also provide a wide variety of

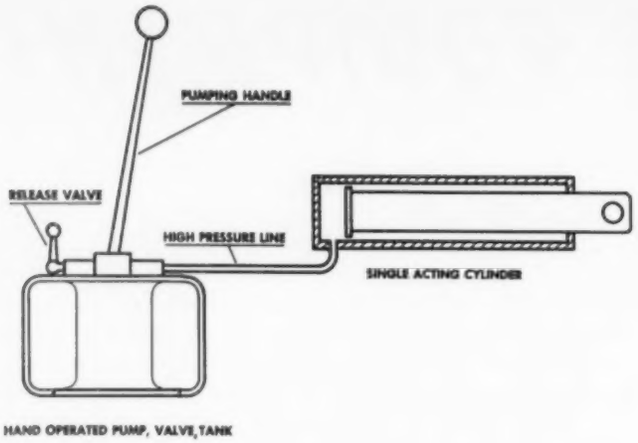


Figure 1 — The basic elements of a hydraulic system are a pump, tank, control valve and cylinder.

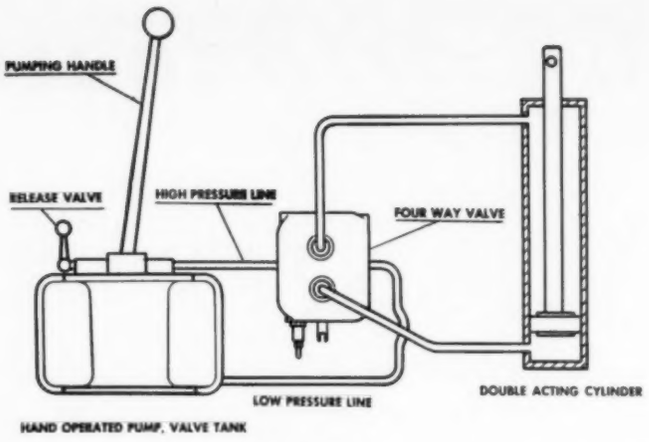


Figure 2 — Addition of a four-way valve allows the use of a double-acting cylinder.

motions which can be rotary, push, pull or straight line transmission of power, and variations or combinations of all the above. The control of this power can be manual or automatic, cycling, by means of servomechanisms, and can be directed from remote points or at first hand where the operator is standing.

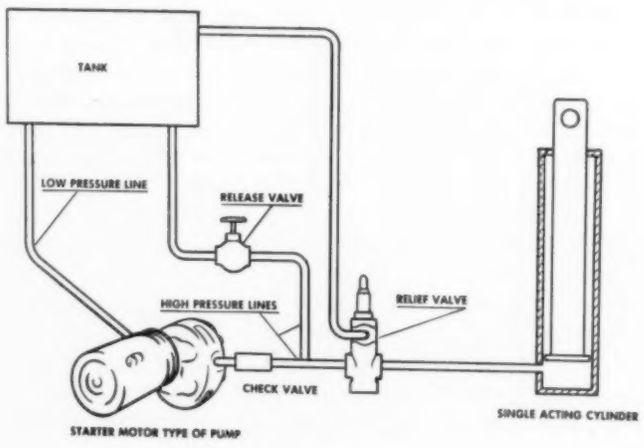
Naturally there are problems and the very flexibility of the system creates some of these problems. Since fluids have no shape of their own, they must be confined positively throughout the entire system. We must provide proper oils to prevent foaming and premature breakdown, and to prevent the accumulation of rust and dirt in the system and possible detrimental chemical action. Above all it is necessary to know how a hydraulic system works, in terms of the general principles common to the particular set-up that may be required.

The foundation of all hydraulics is based on Pascal's Law. Pascal is credited with having discovered that "pressure set-up in a liquid acts equally in all directions and this pressure acts at right angles to containing surfaces." Liquids have no outer form of their own and because of this shapelessness, can be led anywhere in a pipe or hose by means of gravity or by applying forces to them. In ease of transmission, they are second only to electricity and in fact go anywhere without gravitational effect and require only a conductor. It is also well to remember that in spite of the fact that liquids have no shape of their own, they are even less compressible than most solids so that when a force is applied to a confined liquid, it exhibits substantially the same affect of rigidity as a solid.

One of the most inexpensive but very effective types of hydraulic power is that which is employed in the ordinary hydraulic automobile jack. There are variations of this design which are even more powerful, because the hydraulic cylinders which do the actual lifting are bigger in area. They are used effectively by house movers and construction men for lifting very heavy loads. This circuit is as simple as can be devised and in many applications take advantage of the circuit and separate it into component parts in the manner illustrated in Figure 1. The main point of separation in this particular case is that the pump, tank and control valve have been left as one unit, but the hydraulic cylinder has been divorced from the unit and is connected to the pump with high pressure hose so that the cylinder is portable. By any mechanical leverage chosen, it can be used in a horizontal position, upside down, sideways or to suit any requirements. Figure 1 shows the application of a single-acting cylinder by which means hydraulic power is exerted in one direction only. To operate, the pump handle is worked back and forth with the release valve in the closed position, and as pressure is generated the cylinder piston pushes out to the stroke that is required. When the handle is released, the load stays in place because of the check system which is self-contained in this type of pump. These pumps are generally piston type and are capable of creating pressure from zero to sometimes as high as 10,000 psi. When it is desired to lower the cylinder or make a change in its position such as retracting the cylinder, this can be accomplished by opening the release valve, allowing the oil to escape back to the tank. Minute adjustments in the position of the jack are, therefore, possible.

In Figure 2 the same pump is shown but a four-way valve has been added, allowing the use of a double-acting cylinder with this same pump and providing power in two directions, either push or pull as the operator elects. In this case the pump is handled in exactly the same manner, but the release valve is left in the

Figure 3 — This circuit uses a starter motor.



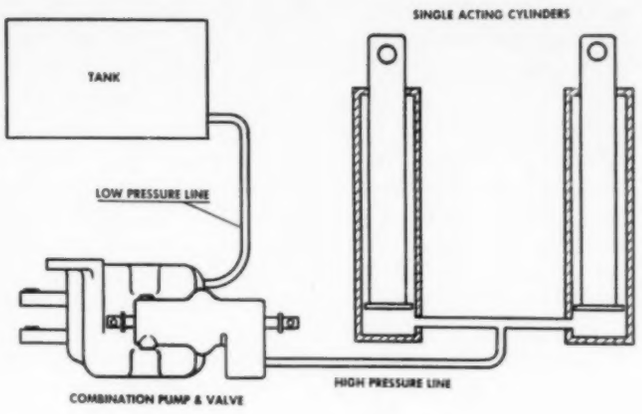


Figure 4 — Scheme shown is commonly used in dump bodies.

closed position at all times and the fluid control is handled entirely by the four-way valve which, upon releasing the oil from one or the other end of the double-acting cylinder, directs the return flow from the valve directly to the bottom of the tank by a low pressure line. As a safety factor for this type of equipment, it is sometimes desirable to place a relief valve in the high pressure line which returns any released oil to the tank. Some designs incorporate this relief valve within the pump itself and in other cases it can be added as a separate unit.

Common applications of either of these two systems are found on industrial lift trucks; the snow plows on our street have the blades lifted by this very system; and in any body straightening shop, the mechanics will be found using a system like this for straightening fenders, bumpers and frames.

The two systems just mentioned were manually operated. In this day and age where the manhours are checked with a critical eye, operations can be speeded up by employing power for the work of pumping. This brings us into a slightly different phase of hydraulics.

In the balance of this discussion the systems mentioned will have a maximum range of from 1000 to 1500 psi. In Figure 3 a very simple circuit which generally employs a starter type of motor connected directly to the pump is illustrated. In this circuit there is a tank which can be mounted with the pump or remotely as the designer elects, and a low pressure line leading the oil from the tank to the pump. To extend the single-acting cylinder which is shown, the operator pushes the starter button and the motor drives the pump which then creates pressure in the high pressure line. Releasing the starter button stops the pump. With the release valve closed, all of the oil has to go to the single-acting cylinder and as long as the pump is running, oil will continue to be forced into the cylinder which would then extend to the required stroke. If an obstruction should be met, and if the pressure requirement should be beyond the capacity of the motor to drive the pump, the stopping or slowing down of the motor will indicate generally that this point has been reached. No oil will return through the pump as the check valve which is placed in the system will prevent the oil from backing into the tank. Since there are times when a powerful motor will be used to drive the pump, it is possible that enough power can be generated so that pressures beyond the safety factor of the pump will be reached. In such cases it is suggested that a relief valve be introduced in the line so that when a predetermined pressure is reached it will empty this excess oil into the tank. To lower, the release valve, which can be an ordinary globe valve, is opened and as much oil released from the cylinder as might be required to lower it to the proper position.

In Figure 4 a very simple and compact type of assembly is illustrated where a source of power is employed consisting of a complete pump and valve combination with a separate tank and high pressure lines leading to one or more cylinders that are single-acting in operation. This is the everyday dump-body circuit. Here again variations exist which are as many as there are manufacturers of dump bodies, although most of them employ the same fundamental scheme. In the lighter duty equipment they depart from the separated tank, pump and cylinder combination shown in Figure 4, and combine them into a unit that is inter-connected by means of castings with adequate trunnioning. Again in this line of work they depend upon either a relief valve in the high pressure line which directs the excess oil back to the tank, or in the case of many units, they have a by-pass system so that when the cylinder plunger reaches the end of the stroke it uncovers a port which

Figure 5 — In this system the pump is in continuous operation.

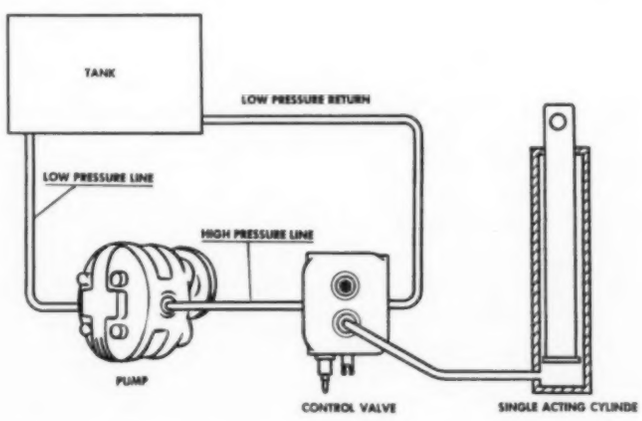
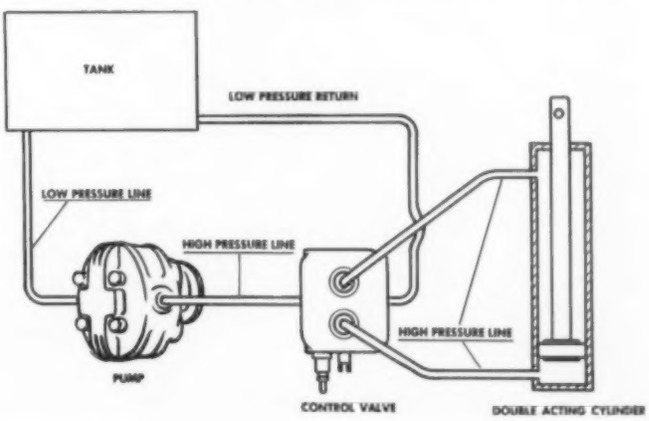


Figure 6 — Scheme is same as Figure 5 but modified for use with double acting cylinder.



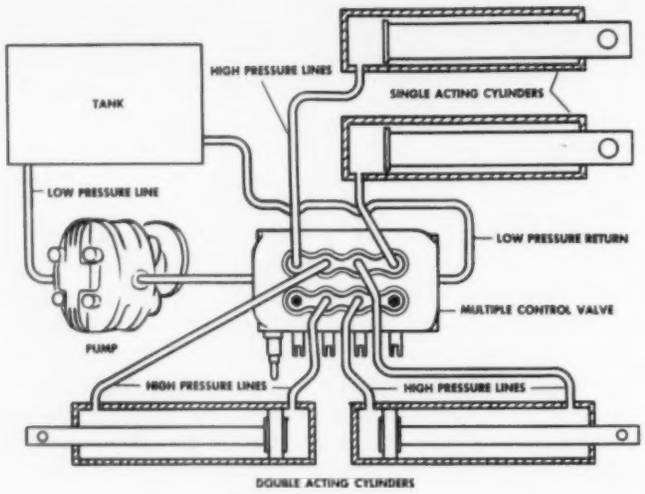
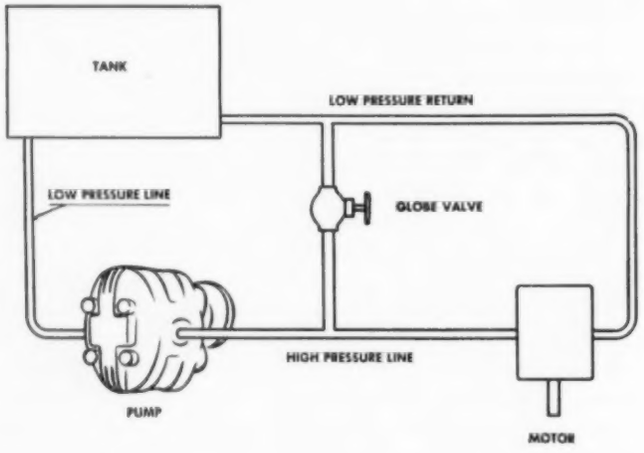


Figure 7 — A number of cylinders can be used and they are controlled independently by the valve arrangement.

Figure 8 — A simple circuit which is used when rotary motion is required.



allows the relief oil to circulate and thus keep down the pressure within the requirements of the operation. In some of the heavy duty designs where telescopic cylinders are used and where the pressures are required to lift very large loads, a separate relief valve gives adequate protection as the pressures will vary with the position of the cylinder in each part of the stroke and will also vary due to the difference in diameter of the various telescoping sleeves. The source of power for this type of equipment is generally a power take-off arrangement, with two shafts, as shown in Figure 4, on the pumping unit itself. These shafts are extended from the pump so that the pump can always be operated in one direction of rotation, but since the source of power may have right hand or left hand rotation, which is unknown until the particular transmission and chassis is selected, the pump can be taken from stock and used immediately without any alteration by the proper selection of one of the two pump drive shafts.

The circuits discussed so far are comparatively intermittent in usage. For heavier duty application it is desirable to have a different type of circuit such as illustrated in Figure 5. Here a pump capable of continuous operation is used with the oil circulating at all times and preferably at no pressure when no power is needed. This means that the valve construction has to be such that, as the oil is circulating, it is directed from the pump through the valve and then returns to the tank, making a continuous circuit. When power is required the valve spool is thrown into the position for raising the single-acting cylinder and the oil is diverted from the pump to the cylinder, which can be placed in any position for the best mechanical advantage. Upon reaching the point of extension that is required, the valve spool is returned to the neutral position. In this position the oil from the pump circulates freely as previously described, but the passage from the cylinder to the valve is blocked within the valve so that the cylinder is held in position.

In Figure 6 identically the same circuit is illustrated as in Figure 5 except that a double-acting type of cylinder is used. The same type of valve construction is employed except that the circuit within the valve itself is designed to handle the double-acting cylinder. In the circuits illustrated in Figures 5 and 6, a relief valve is usually incorporated within the valve itself so that as relief pressures are reached the relief valve opens and the excess oil returns through the low pressure return line to the tank, and thus dissipates its heat within the volume of oil contained in the tank.

Figure 7 is a continuation of circuit, Figure 5 and Figure 6, except that additional cylinders which are to be controlled independently, but with a minimum of valving, are added to the circuit. This is accomplished by identical means illustrated in the last two circuits, but with a multiple type of control valve where as

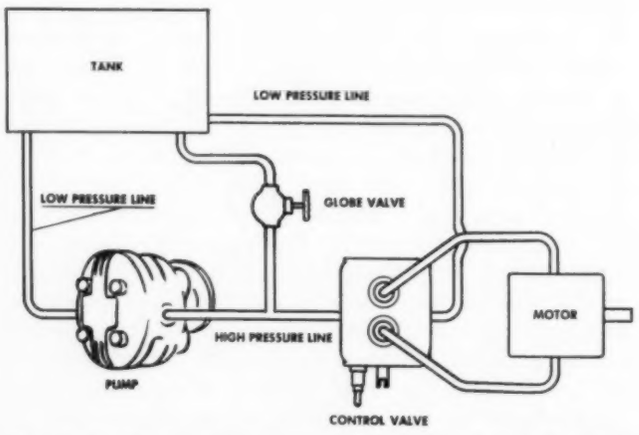
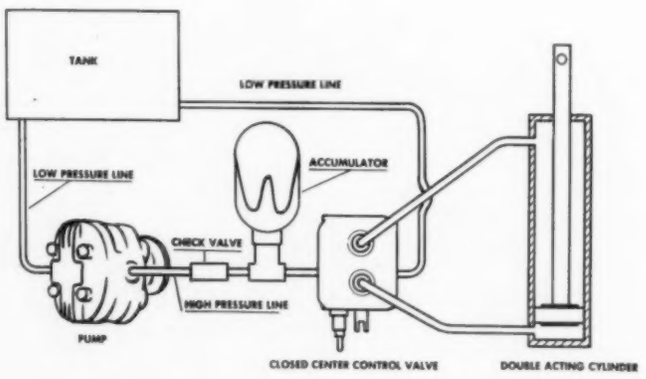


Figure 9 — The motor shown in this circuit can be driven in either direction.

Figure 10 — This sample circuit is used for many different types of work.



many cylinders are individually controlled as may be required. There also exist valves that permit operation of all cylinders simultaneously, but they are found rather impractical since it is to be remembered that the cylinder requiring the least amount of pressure to raise will always advance first, and as this system becomes nothing but a manifold system in the average valve, the cylinder with the heavy load may actually drop its load and the oil coming from the dropped load may help to push the cylinder with the light load to its extension. For certain specialized uses, there are some multiple valves that are so constructed that they are used for double-acting cylinders only, where two or more are to be operated simultaneously. This is accomplished by passages within the valve which directs the oil from one side of one cylinder to a second cylinder and, if the volume requirements are synchronized properly, is very effective for those particular needs.

Up to this point, simple circuits where straight line motion and push or pull requirements are needed, have been discussed. There are, however, many places where rotary motion is required which can only be supplied by hydraulic motors. In this particular initial circuit shown as Figure 8, the same type of tank and pump illustrated in the preceding circuits 5, 6 and 7, is used. As long as the pump is operating and the by pass globe valve is closed, the motor will operate in one direction only. As the oil leaves the motor, it returns to the tank and circulates so that the oil should, with proper circulation, be comparatively cool. To vary the speed of the hydraulic motor, the globe valve is opened to by-pass some of the oil to the tank and to regulate the oil flow to suit requirements. This, of course, is a very simple way of doing it and is intended only as an illustration of the possibilities of hydraulic motor circuits.

Figure 9 illustrates identically the same circuit except that in this case a control valve is inserted which allows the motor to be driven in either direction. This circuit generally contains a relief valve in it so that if an obstruction is met by the motor, the oil pressure is relieved and the motor stops until the obstruction is removed. The reversal of this motor is accomplished by a simple push or pull on the control valve spool and is instantaneous as long as the pressures are within the limitations of the system. This is a very effective means of securing rotary motion and if a hydraulic motor is made within the range of the requirements, a little used but effective source of power becomes available. The globe valve again is illustrated as representing the possibilities of varying speed by by-passing oil to suit the requirements.

Another simple circuit, Figure 10, which is often employed for different types of work is one which more nearly represents some of the older steel mill applications where the accumulator type of system was used. This is a circuit where a tank and a pump is used as in previous circuits but where the valve itself is a closed center type which does not allow the oil to bypass through the valve when it is in neutral position as in the previous circuits. Here is also employed a check valve so that once the oil has left the pump it cannot return. This means that as the oil is dead-ended in the closed center valve and cannot return to the pump, a pressure and volume is built up in the accumulator representing kinetic energy ready for use at any instant.

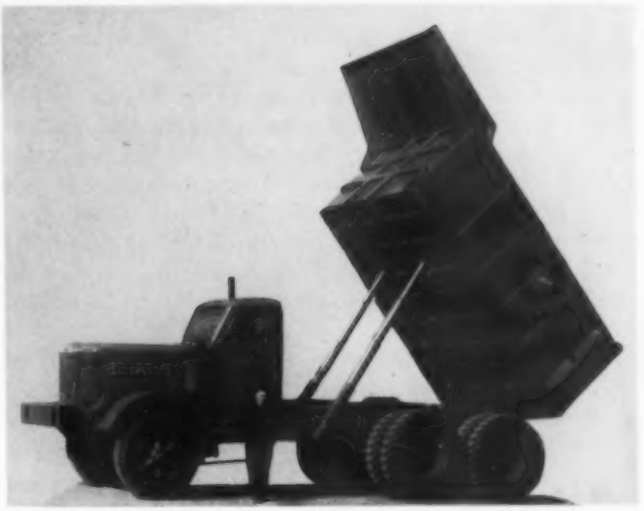


Figure 11 — Dump bodies are usually activated by a hydraulic system.

A double-acting cylinder is shown in Figure 10, but a single-acting cylinder or the multiple type of cylinder bank can be as easily employed. Generally in this type of system an electrical pressure control provides a means of cutting the motor in or out for driving the pump to maintain constant pressure in the accumulator. In many cases where the cylinders have a large volume requirement, the pump may continue to operate when the cylinder is extended and the accumulator then becomes a dampening device which eliminates some of the possible pulsations in pressure that might result.

The following illustrations are typical examples of the every day application of oil-hydraulic systems:

Figure 11 uses a single-acting telescopic cylinder with a pump and control valve circuit as previously described

Figure 12 — A typical hydraulic usage is in lift trucks.

in Figure 2 or 3. The cylinder in this application raises or lowers the body as required.

Industrial lift trucks as illustrated in Figure 12 employ a hydraulic circuit using a combination of a single-acting cylinder for lifting the load and a double-acting cylinder for tilting the mast. Hydraulic power is provided by a pump connected directly to the engine of the truck with the hydraulic power controlled through a combination valve controlling both the single and double-acting cylinders similar to the circuit described in Figure 7.

A further development of the same circuit used on industrial lift trucks is illustrated on a front end loader, by which the raising, lowering and tilting of the bucket is controlled by a combination of double-acting cylinders with a pump and a multiple control valve.

As additional accessories are added to the various machines, the hydraulic circuits apparently become more complicated but actually are simply an enlargement of the single and double-acting circuits that have been previously discussed. By taking these simple circuits and applying hydraulic power through leverages, practically any type of motion and any amount of power can be made available and can be easily controlled by the operator of the machine. In practically all of the equipment the pumps, valves and cylinders used in the hydraulic circuits are usually of a standard stock design made in large volume and comparatively inexpensive. In virtually no application is nonstandard equipment required.

CURRENT AISE DISTRICT SECTION MEETING NOTICES

BIRMINGHAM SECTION

Friday, December 14, 1951

Christmas Dinner and Dance

Thomas Jefferson Hotel, Birmingham, Ala.

▲

BUFFALO SECTION

Saturday, December 8, 1951

Christmas Dinner and Dance

Hotel Statler, Buffalo, N. Y.

▲

CHICAGO SECTION

Saturday, December 8, 1951

Christmas Dinner and Dance

Hotel Sherman, Chicago, Ill.

▲

CLEVELAND SECTION

Saturday, December 1, 1951

Christmas Dinner and Dance

Allerton Hotel, Cleveland, Ohio

DETROIT SECTION

Friday, December 7, 1951

Christmas Dinner and Dance

Detroit Yacht Club, Belle Isle, Detroit, Mich.

▲

PHILADELPHIA SECTION

Saturday, December 1, 1951 — Dinner 6:30 P.M., Meeting — 7:00 P.M.

"Delivery of Torque to Rolls" by Louis Moses, Superintendent, Rail Mill and Roll Department, Bethlehem Steel Co., Sparrows Point, Md.

"Colored Slides and Motion Pictures of the Bear Tooth and Grand Teton Mountains and of Yellowstone Park" by A. J. Fisher, Assistant Chief Engineer of Construction, Bethlehem Steel Co., Bethlehem, Pa.

Engineers Club, 1317 Spruce St., Philadelphia, Pa.

▲

PITTSBURGH SECTION

Friday, December 14, 1951

Christmas Dinner and Dance

William Penn Hotel, Pittsburgh, Pa.

WASTE TREATMENT IN THE MODERN STEEL MILL

. . . . industrial waste treatment is a problem which steel plants are now attacking vigorously . . . .

By J. E. COOPER*
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▲ THE steel industry, from the ore mines, blast furnaces, coke ovens, steel furnaces, finishing mills, and manufacturing activities which produce finished products, is now gearing itself to an all-out effort towards stream pollution abatement. In the short space of this paper, it is obviously impossible to discuss the various treatment methods which apply to all segments of the industry, rather, mention will be made of specific installations along with descriptions of specific waste problems with the author's comments and experiences concerning these.

There are few in industry today who are not aware of the increasing efforts of governmental agencies to press for complete installations which correct the adverse characteristics of the effluents from industrial plants.

Newspapers have been carrying on a running fight, and aided and abetted by the very active and well organized sportsmans groups, it is apparent that conditions previously accepted as normal practice in steel mill operation have now become intolerable when considered from a stream pollution standpoint.

Such a boom in pollution control activities has of course brought many people and groups into the field who are novices in sanitary engineering problems. For example, the terminology generally used in sanitary engineering to denote concentrations of polluting substances and to describe the physical and biological characteristics of a stream or polluted water leaves many steel mill engineers at a loss to evaluate or place their plant or problem in a proper perspective.

One of the most helpful and enlightening factors is the cooperative attitude and assistance which the Municipal, State and Federal pollution control agencies are giving or offering to industry in an effort to mutually assist each other in the solution of common problems. An example might be the Industry Action Committee for the Steel Industry formed this year by the Ohio River Valley Water Sanitation Commission. Another activity on a broader scale is the Technical Task Committees which are being established to advise the Surgeon General and the United States Public Health Service on the problems which confront various segments of industry in the solution of their waste problems. Certainly such getting together is to be commended and the persons contributing to such mutual assistance are especially worthy of commendation.

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Today the indiscriminate discharge of polluting substances to streams from new industries is largely a thing of the past. Most states now require that new plants, or substantial changes within existing plants, be first approved by the State Pollution Control Agency, and that the required treatment methods be installed at the time the changes are made. This of course will eliminate new pollution, however, what to do with existing pollution remains one of the largest "bugaboos" facing the steel industry at the present time.

Phenol and spent pickling acid are those wastes most commonly associated with the steel industry. To these are added oil, cyanide, flue dust, mill scale, ammonia, naphthylene, and the metal finishing wastes in amounts varying according to the type of operation.

PHENOLS

Phenols from coke oven plants, are those wastes which have a direct bearing on the well-being of the general population since they adversely affect their public water supply.

There are two general processes in commercial use for removing phenol from ammonia still wastes.[1]* One is a solvent extration method in which an oil solvent is used to extract the phenols from the liquor and the other depends on volatilization of the phenols from the liquor by means of steam.

In the first, ammonia liquor is washed with the crude light oil recovered at coke plants. The oil extracts the phenols from the ammonia liquor and is then washed with a caustic solution to remove the phenols from the wash oil. The oil is thus regenerated for further use in phenol extraction and the phenol, as sodium phenolate, accumulates in the caustic solution. When as much as the caustic soda as practical has been converted to sodium phenolate, the solution is removed for recovery of phenol and is replaced with fresh caustic.

In the volatilization process, steam is recirculated through the ammonia liquor, then through a caustic solution. In this manner a high grade of recovered phenol is produced.

Each of the above processes with some variations, can recover 90-95 per cent of the phenol, however it is

*Refer to Bibliography at end of article.

interesting to note that an ammonia still waste containing, for example, 2500 ppm of phenol, of which 95 per cent was recovered by such a process, would still contain 125 ppm of phenol. This would require a dilution of 6,250,000 gal of water per 1000 gal of waste in order to meet the effluent objectives of the International Joint Commission for the Boundary Waters.[15] When it is considered that about 22 gal of still waste is produced per ton of coal carbonized,[2] a battery of ovens handling 3000 tons of coal per day would produce 66,000 gal of still waste. Carrying the above calculations a bit further, such a coke plant even with a dephenolizing installation would require 412,000,000 gal a day of dilution water for their treated wastes from the ammonia still alone to meet an effluent restriction of twenty parts per billion (20 ppb).

The above illustration is shown simply to point out that the effluent objectives of the International Joint Commission cannot be met simply by installing a known commercial phenol recovery process. Sufficient dilution water must be available or additional effluent treatment provided to meet such stringent desires.

Other methods of phenol recovery or disposal such as the use of activated carbon for adsorption or pumping the still waste to the coke quench, have been proposed and tried but find objection for a variety of reasons.

Research is under way in a number of locations on the phenol problem. The U. S. Public Health Service, through its Industrial Waste Section, is studying the effect of various operating procedures on the production of wastes at various coke ovens around the country. Mobile laboratories and a team of chemists and engineers are presently engaged in this work.

At the Armco Steel Plant at Hamilton, Ohio,[3] a cooperative study is being carried on by the Ohio River Valley Water Sanitation Commission, the State of Ohio, the U. S. Public Health Service, and a number of manufacturers on the use of chlorine, chlorine dioxide, and ozone for phenol destruction. A pilot plant, to test these procedures, is now ready for operation to attempt the duplication of the successful initial laboratory studies. It is hoped these researches will provide a means to get at the traces of phenol with an economical and simple treatment.

ACID WASTES

Acid wastes from the steel industry vary widely in chemical characteristics, depending on whether they result from batch discards of spent acid baths or from continuous rinsing operations. The greater problem lies in providing satisfactory treatment of the batch discards and discussions below will be directed primarily at that type of waste. It is rather surprising to some though, to learn that according to Siebert[4] 85-90 per cent of the spent acid and metals in a strip mill are lost in dilute rinse waters and only 10-15 per cent in the spent pickle liquor batches.

Utilization of the volume and natural alkalinity of receiving waters for disposal by dilution is the simplest and most commonly used method of acid disposal.[5] To be effective, there are four basic requirements which must be met:

1. There must be an ample volume of receiving water to provide sufficient dilution.
2. There must be sufficient alkalinity in the receiving water to neutralize the added acid.
3. The wastes must not contain other pollutants whose concentration remains excessive.
4. Adequate dispersion must be provided to eliminate local concentrations of the waste in the receiving water.

Since the greater share of acid waste problems are associated with the intermittent rapid discharge of such wastes to a sewer or stream, holding facilities are required to extend the discard over a period of time.

Referring again to the International Joint Commission objectives,[15] it is interesting to note that the iron (Fe) in waste pickling liquor, not acid, is the constituent which limits controlled dilution. Experiments made while the author was still at the Ford Motor Co. indicated that the Detroit River could assimilate 290 gal of acid pickling liquor containing 7.3 per cent H_2SO_4 and 5.35 per cent iron (both wt/vol) per million gal of river water when acid alone is considered. Based on the iron limitation, though only 4 gal of waste per million gallons of water could be disposed of in such a manner.

Neutralization is the second most common method of disposal. Varying degrees of treatment are practiced depending upon the receiving stream or sewer system. In the case of some mills, neutralization with lime to a pH of 6.0-8.0 followed by disposal of the batch to the city sewer system is practiced. This applies especially in the large cities such as Detroit where the sludge does not interfere with sewage treatment. In larger mills and those in populated areas, the problem of final sludge disposal presents the most difficult hurdle. Neutralized sludge is a gelatinous slimy mass with a very low per cent of water. It resists mechanical dewatering with vacuum filters, centrifuges, etc., and lagooning is about the only practical disposal method. Recent research on neutralization has been largely directed at methods of producing a filterable sludge.

A recent development by Hoak,[6] neutralization along with oxidation by air at controlled temperatures, offers promise that a filterable sludge of low volume can be produced.

For a more complete description of the lime neutralization techniques the reader is referred to the excellent studies given by references (7), (8), (9), (10), (11).

Sewage sludge conditioning with waste steel pickling liquor[12] is a new development which may offer an outlet

Figure 1 — Indirect cooler portion of new final cooler water recirculating system at Ford Motor Co. coke oven plant.

for limited quantities of the waste. In this process, settled sewage sludge is made amendable to dewatering over vacuum filters prior to incineration. At the present time, both the cities of Detroit and Dearborn are using this process.

Sewage coagulation, that is, assisting the sedimentation of solids from sewage, is another use for the pickling liquor. Unfortunately, the quantity which can be consumed is limited, thus this method provides an answer to only some of the strategically located mills. Coagulation of water has been practiced at the City Water Filtration Plant at Akron, Ohio,[13] using waste steel pickling liquor which has been chlorinated.

ACID AND FERROUS SULPHATE RECOVERY

Many processes have been proposed and various ones installed to recovery acid and ferrous sulphate from waste steel pickling liquor.

Hodge[14] described most of these processes and patents and presented a list of 138 references which are extremely useful. Rather than again describe these methods, below are those which appear to this author to have appeal and worthy of further investigation and development.

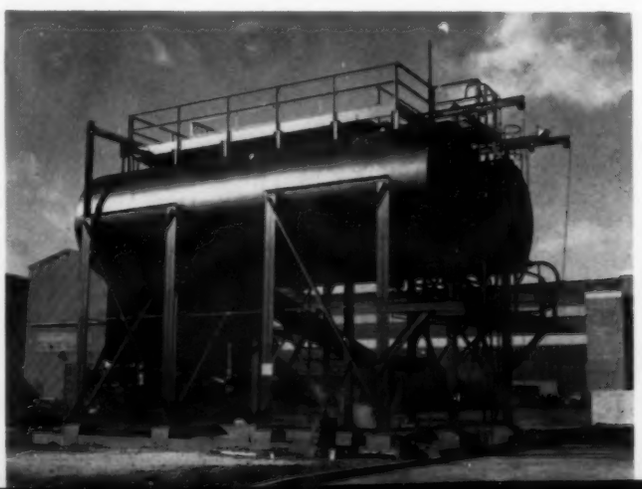
One of the most intriguing processes is that which depends on the use of differential solvents to depress the solubility of the ferrous sulfate. Methyl alcohol, acetone, or a number of other solvents will accomplish this. The spent liquor is merely agitated with equal volumes of solvent, and the ferrous sulphate immediately crystallizes from solution. The solvent is then stripped from the decanted acid-solvent mixture and recycled. The acid is returned to the pickling tanks for reuse.

Another process on which this author has been carrying on research and development is that of removing ferrous sulphate from spent acid wastes by refrigeration. In such a process, the pickling liquor is reduced to a temperature of 25-30 F and the crystallized copperas removed. The remaining acid solution is re-cycled through heat exchangers back to the pickling bath. There is further pilot plant study in order, however, this method appears to hold real promise in providing a continuous package-type acid regeneration plant.

One promising study carried on some years ago by this author and his staff at the Ford Motor Co., was the neutralization of pickling liquor with lime after the pickling liquor had been diluted with a large volume of water. In this process, the dilution was great enough that the calcium sulphate formed remained soluble and only pure iron hydrate (a mixture of ferrous and ferric) was formed. The object was to produce a hydrate of such purity that it could be spray dried and chemically reduced to form powdered iron.

If a satisfactory dewatering method could be found for the slurry from such a neutralization so that it could merely be sent to a sinter plant, the process would be a very attractive neutralization method. Sludge dewatering again remains the difficult problem.

Figure 2 — Holding tank for spent acid pickling liquor at Ford Motor Co., Dearborn, Mich. From here the waste is trucked to Detroit Sewage Plant for use in sewage treatment.



OIL WASTES

Oil in cooling water from scale pits in rolling mills is one of the most common sources of pollution. Such oil is seldom emulsified to any extent and can be readily skimmed from the surface of the cooling water by a gravity separator.

It is possible that some of the new type skimmers being developed for the oil industry might be applicable to skimming oil directly from scale pits in spite of their varying water levels.

Spent soluble oil emulsions from machine shop and roll grinding operations should be segregated and the emulsion broken separately. Numerous methods are available such as the use of calcium chloride in batch treatment tanks for treatment of spent emulsions. Efforts should first be directed, however, toward extending the useful life of coolants by the controlled addition of disinfectants and the continuous removal of grinding solids.

CYANIDE WASTES

Toxic cyanides in steel mills originate at three main sources:

1. Washed from the gas in the final cooler water of the coke ovens.
2. Spent heat treat residues.
3. Electroplating.

Treatment of the final cooler wastes usually is accomplished by closing up the system and re-circulating the water over a cooling tower. The cyanides are then lost to the atmosphere. At Ford, a new re-circulating system of a novel design has been installed where the final cooler water passes through indirect cooling coils. In this way, the concentration of cyanide builds up in the circulating water to an equilibrium after which no further cyanide is scrubbed from the gas.

Treatment of spent cyanide residues from heat treat and plating operations involves the installation of a simple batch treatment plant at which the cyanide is treated with alkali and chlorine. Cyanide is decomposed in such a treatment to carbonate and ammonia.

NAPHTHALENE

Naphthalene is a waste from the final cooler water which is a greater pollution hazard than generally

Figure 3 — Setting float level recorder during a waste survey.

recognized. It is toxic to fish in low concentrations and is the cause of many odor complaints wrongly attributed to phenol.

Recovery consists of either:

1. Installing a recirculating system on final cooler water and skimming, centrifuging and drying the naphthalene which accumulates in same.
2. Installing a tar extraction system whereby the naphthalene is extracted from the recirculated final cooler water with tar.

FLUE DUST

Losses of solids to the atmosphere is now being attacked by many local air-pollution control authorities and as a result, there is a tremendous upswing in the installation of dust collectors in steel mills. Of these, the wet type may create a stream pollution problem unless adequate means are initially installed to remove the solids from the waste air wash water. Mechanical water clarifiers which permit the continual discharge of both separated sludge and clear effluent are utilized to keep the solids from contributing to stream pollution.

Usual flue-dust thickeners which recover the bulk of the solids from blast furnace dust collectors are often major sources of stream pollution. They are very efficient when only the value of the recovered solids is considered but many are notoriously inefficient when the effluent is considered based on its effect upon a stream. Secondary treatment, consisting of the addition of a chemical coagulent to a secondary settling unit of the type of settling used in water and sewage treatment appears to be a coming practice in further purification of wet washer waters.

SUMMARY

The above presentation has referred to specific waste problems within a steel mill.

Insofar as the large volume of miscellaneous waste water from the steel plant is concerned, it is recommended that the total flow pass through a simple treatment plant where the following functions are performed:

1. All coarse solids etc., should be settled in a primary settling unit of short detention where scale and large solids can continuously be removed.
2. The partially clarified water should then pass to a circular or rectangular settling unit of the newer type designs which provide for a high efficiency of fine solids removal in a relatively small area.
3. Provision should be made for continuous removal of solids from the settling basin by means of sludge flight collectors and continuous skimming of oil from the surface.
4. Ordinarily, when the above three steps are taken, the controlled addition of a small amount of coagulant will clarify the effluent so exceptionally well that it should be recirculated for use again in the mill rather than discarded. Very often it is much clearer than the raw river water.

In place of putting in a separate concentrator, as in item 2 above, the Ford Motor Co. is cooperating with one equipment manufacturer on the development of a continuous scale removal device which will remove the larger scale from scale pits right at the job. The value in such a system is readily apparent.

The Alan Wood Steel Co., at their Ivy Rock, Pa. plant, recently installed a system similar to that described above. The Armco Steel Corp., at their Middletown, Ohio plant, is now installing such a treatment plant. The U. S. Steel Co., in one of their Eastern plants, is reported to be planning secondary treatment (improved purification) to clarify their blast furnace thickener overflow.

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INSTRUMENTATION FOR IMPROVED ROLLING TEMPERATURE CONTROL

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. . . . adequate instrumentation is essential in obtaining the most efficient rolling operation . . . .

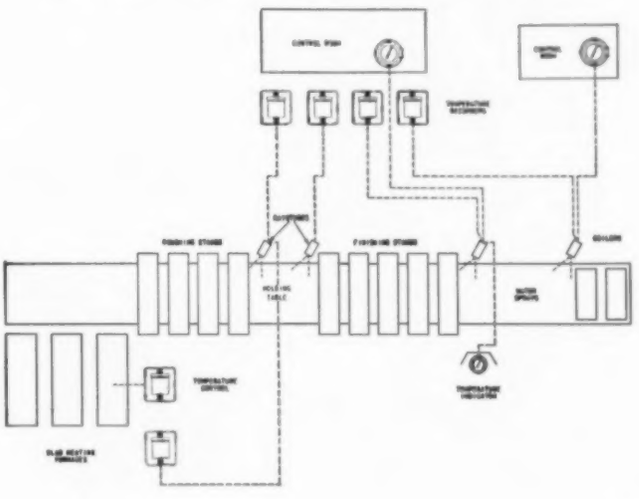
▲ THIS paper will discuss the very important part that temperature plays in the rolling of quality steel product and also describe the instrumentation that is available for measuring, indicating, and recording these temperatures. In general, the temperature problem is quite similar in the various types of rolling mills whether they be rod mills, rail mills, merchant mills, strip mills, etc. In the average mill we first become interested in temperature in the reheating furnace. From this point on down through the mill, temperature is an important consideration during the various stages of rolling until the finished product finally leaves the mill.

For our discussion we will consider more specifically the application of temperature instrumentation to the continuous hot strip mill as a typical rolling mill in the steel industry. Temperature instrumentation as applied to this type of mill is probably more advanced and more complete than on any of the other rolling mills.

Figure 1 shows a schematic layout of a typical temperature installation on a hot strip mill. Starting with the slab heating furnaces at the left-hand side, we follow the temperature instrumentation down through the roughing mill, the finishing mill, and on to the coilers or pilers. We will now consider in more detail the equipment used for making these various temperature measurements and the purpose each serves in improving overall rolling practice.

Starting at the slab heating furnaces, we are faced with probably the most important temperature problem in the entire mill. There has been considerable improvement in design of slab heating furnaces since the original furnaces were built for the first continuous hot strip mills. These improvements in furnace design have made possible the use of automatic temperature control, air-fuel ratio control, and furnace pressure control to provide uniformly heated slabs at the proper temperature for rolling. Considerable work has likewise been done in improving the automatic controls on these furnaces. The average temperature control on these furnaces measures and controls a temperature which is probably more closely related to the furnace temperature itself than to the slab temperature. Under continuous operation this method of control is fairly satisfactory but it is very unsatisfactory during times of mill delay, particularly if the delay extends over a fairly long period of time. With the conventional type of control the operator must reset the various temperature control points at the start of these delays and then must again reset these control points when the mill begins rolling. Therefore, the quality of heating is dependent very much upon the operator's judgment and his alertness and even under the best of circumstances considerable overheating and underheating is experienced at these times. In an effort to improve temperature control, considerable work has been done to satisfactorily measure slab temperature rather than furnace temperature and a complete report on some of this work is covered in a paper presented by Mr. Fred S. Bloom at the annual AISE Convention in Cleveland in 1948.

Figure 1 — Schematic layout for a typical temperature installation on a hot strip mill is given here.



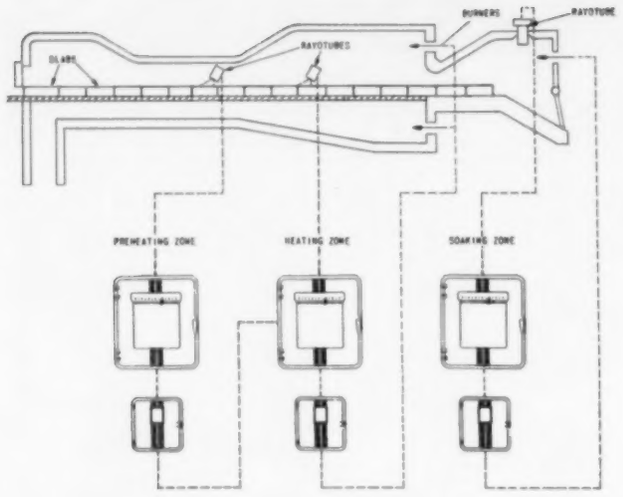


Figure 2 — Temperature control for slab heating furnace.

See "Controlling and Measuring Steel Temperatures in Billet Heating Furnaces," Proceedings AISE, 1949, p 670. According to Mr. Bloom's paper, the quality of heating was improved considerably when radiation pyrometers were employed to sight directly upon the slabs in the furnace to measure slab temperature as compared to previous practice of sighting into closed end tubes measuring essentially furnace temperature. The direct measurement of slab temperatures in a furnace presents sizeable problems in avoiding flame and smoke plus the problems of non-uniform loading of the furnace, loose scale on the slabs, etc. However, in spite of these difficulties, it has been found possible to obtain satisfactory results by careful installation of the equipment for measuring slab temperatures in the furnace.

The temperatures measured by this method are surface temperatures and their relation to average slab temperature or to center slab temperature depends upon the degree of soak. Here again under continuous operation, the degree of soak at any particular place of measurement in the furnace will remain fairly constant and the measurement of surface temperature becomes indicative of average slab temperature. However, during times of mill delay or even during times of mill speed-up, the degree of soak changes, and slab surface temperature bears a different relationship to average slab temperature. In order to compensate automatically for the variable degree of soak encountered in the normal operation of these furnaces, a special temperature control system has been devised which utilizes a temperature-difference or temperature gradient measurement as a measure of the degree of soak.

Figure 2 shows a schematic diagram of this special temperature control equipment which has been applied to a conventional 3-zone slab furnace.

In the soaking zone (right-hand section) it has been found satisfactory to measure furnace temperature as a measurement of slab temperature because of the relatively small differential between these two temperatures. Therefore, in this zone, temperature measurement is made by sighting a radiation pyrometer upon a closed end tube. The closed end of the tube is located in a dished-out section of the roof in order to minimize the direct flame effect upon the tube temperature. This temperature is recorded and is controlled through a proportioning control system by regulating the fuel supply to the front zone burners.

Keep in mind that although we are here limiting our discussion of temperature control to the regulating of the fuel supply to the furnace, neverthless, the effect of air-fuel ratio control and furnace pressure control are very important factors in obtaining good heating practice.

In the heating zone (center section of Figure 2) a radiation pyrometer is mounted on the side of the furnace and sights through an open end sighting tube upon the ends of the slabs measuring slab end surface temperature. By exercising a certain amount of care in charging the furnace it is possible to line up the slabs so that a satisfactory target is provided for this tube. The recording controller, through a proportioning control system, regulates the fuel supply to both the top and bottom burners to maintain the desired slab temperature. The ratio of fuel supply to the top burners as compared with the bottom burners can be set by the operator and does not normally require any further adjustment.

A second Rayotube (left-hand section of Figure 2) located back in the preheating zone of the furnace sights upon the ends of the slabs in a manner similar to the one in the heating zone. This preheat temperature is recorded on a recording controller which instead of regulating a fuel supply to the furnace directly, functions through a proportioning control system to reset automatically the control point setting of the heating zone controller. Under normal operation a temperature-differential is set up between the preheating zone and heating zone controllers and with the furnace in continuous production this differential is maintained. However, during a mill delay, there will tend to be an increase in the slab surface temperatures as well as an increase in the degree of soak. The heating zone controller will begin throttling back on the fuel supply to the top and bottom zone burners, in order to prevent this increase of slab temperature in the heating zone. At the same time, the slabs in the preheating zone will

Figure 3 — The radiation pyrometer is located on the side of the furnace and sights on the end of the slab.

begin to increase in temperature and as this increased temperature is recorded on the preheating zone recorder, it will automatically and gradually lower the control point setting of the heating zone controller. The extent to which this control point setting is lowered is a function of the increase in temperature of the slabs in the preheating zone, which, in turn, is a measure of the duration of the mill delay and a measure of the change in the degree of soak.

Upon resumption of rolling in the mill, the reverse temperature changes take place in the furnace. Colder slabs move into the preheating zone and the preheating zone controller then gradually raises the control point setting of the heating zone controller, which, in turn, increases the fuel supply to the top and bottom zone burners to maintain the desired higher slab surface temperature. Eventually the normal temperature-differential is established between these two controllers.

Thus, a control system has been provided which automatically corrects for upsets in furnace operation and makes the necessary firing adjustments in order to prevent overheating or underheating of the slabs in the heating zone. This insures that the slabs always enter the soaking zone at essentially the same average temperature, and, therefore, all slabs enter the mill at the desired temperature for rolling.

In general, the mill requires that the slab be heated to as high a temperature as possible without melting the scale formation on the slab surface. In order to insure hot slabs and at the same time insure against melting of the scale requires that the temperature control operate within a fairly narrow band necessitating the utmost in accuracy of measurement and sensitivity of the control system.

Figure 3 shows the radiation pyrometer tube located on the side of the furnace sighting horizontally through an open end tube upon the end of the slab. This mounting is used in both the preheating and heating zones.

Figure 4 shows the radiation pyrometer located above the roof of the soaking zone, sighting down into the closed and target tube. Immediately in back of this assembly can be seen the furnace pressure measuring pipes.

Figure 4 — The pyrometer shown here is located in the roof of the soaking zone.

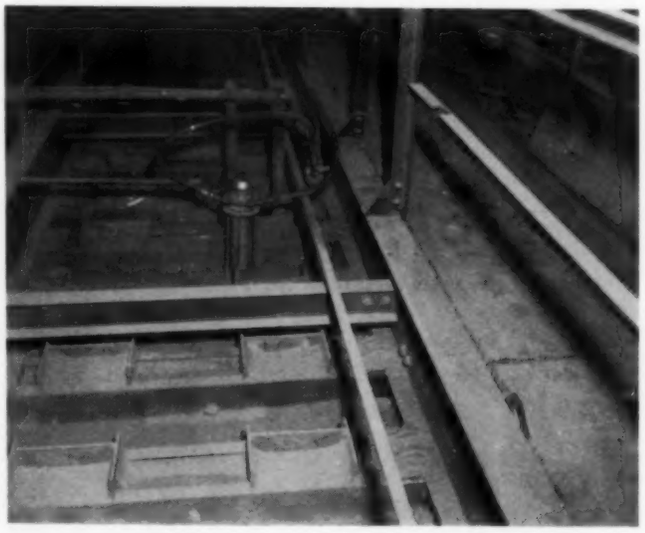


Figure 5 — The temperature recorders are located at a central temperature station below the speed control pulpit of the finishing mill.

Referring again to Figure 1 we will next follow the heated slab as it is discharged from the furnace and starts to move down through the mill. The scale is removed in the scale breaker and the slab is reduced in thickness in the roughing stands. After the last roughing stand, we come to the first point of temperature measurement in the mill proper.

At this point, the steel surface is normally clean and, of course, at these temperatures in contact with air, iron oxide is formed on the surface. This provides a satisfactory condition for measuring the surface temperature either with an optical pyrometer or a radiation pyrometer. The iron oxide surface, even though it is out in the open, has a fairly high and constant emissivity, particularly in the visible range, so an optical pyrometer produces an accurate temperature reading. For example, an optical, calibrated for black body conditions, will give a reading of 1993 F when sighted upon a steel plate which is at a temperature of 2000 F. The reading will be only 7 degrees low. A radiation pyrometer, sighted upon the same steel plate, will give a reading of 1907 F. This reading is 93 degrees low. However, since the emissivity does remain essentially constant, the optical can be used as a means for calibrating the radiation pyrometer under actual operating conditions. This calibration is accomplished by means of an emissivity compensating dial adjustment in the temperature recorder and after once being calibrated, the radiation pyrometer measures the surface temperature accurately.

Before the development of the high speed radiation

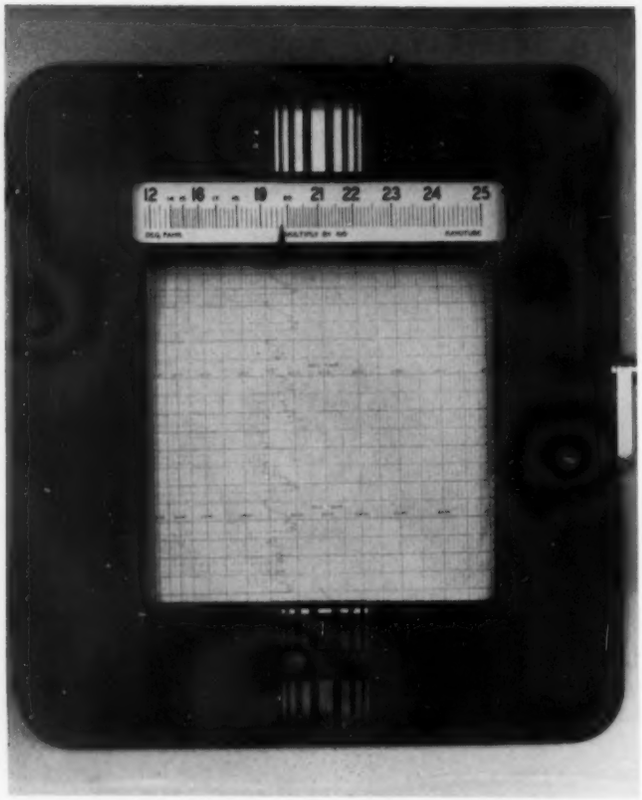


Figure 6 — A typical roughing temperature record.

pyrometer and recorder, the optical was used exclusively to measure the temperature of the steel slab at the various points in the mill. The optical pyrometer is inherently an accurate instrument, but in measuring temperature it involves the "human element" of the operator and has the added disadvantage that the reading cannot be recorded automatically to provide a permanent record. Therefore, the use of the radiation pyrometer has proved to be much more satisfactory for this application. The radiation pyrometer and the recorder must be of the high speed type, particularly at the finishing stands and coilers, in order to provide a detailed temperature record of the fast moving strip. The radiation pyrometer commonly used for these applications has a response time of 1.3 seconds to reach 99 per cent of the reading. The instrument used to record these temperatures is fast enough to keep up with the reading of the pyrometer. The recorder chart is usually driven at a speed of 2 inches per minute in order to provide a detailed temperature record. When temperatures are not being recorded, the chart drive is automatically stopped in order to keep the temperature records close together for convenient inspection.

The temperature measurement after the last roughing stand is recorded back near the slab heating furnaces in order to provide the heater with a record of not only average slab temperature but also temperature variations throughout the length of the slab. This serves as a positive guide to the furnace operator in making control point settings on the furnace temperature controllers and in making burner adjustments to insure uniform heating from one end of the slab to the other. This temperature is also recorded at the central temperature station near the finishing stands to make this record available for the operating and metallurgical departments.

Figure 5 shows the location of temperature recorders at the central temperature station beneath the finishing mill speed control pulpit. Here the record is conveniently available to both the roller and metallurgical department inspector.

Figure 6 shows a typical roughing temperature record. Usually the operators try to maintain a temperature of 2000 F at this point in the mill.

Figure 7 shows a typical mounting of the radiation pyrometer after the last roughing stand.

Referring again to Figure 1, we see that the slab after leaving the roughing stands moves along the holding table to the finishing mill. Before entering the finishing stands, another measurement of slab temperature is made. This temperature measurement is particularly important when rolling steel which is "hot short" in order to make certain that it is below the "hot short" temperature range before the finishing rolling is begun.

Figure 7 — The temperature of the moving sheet is being measured after the last roughing stand.

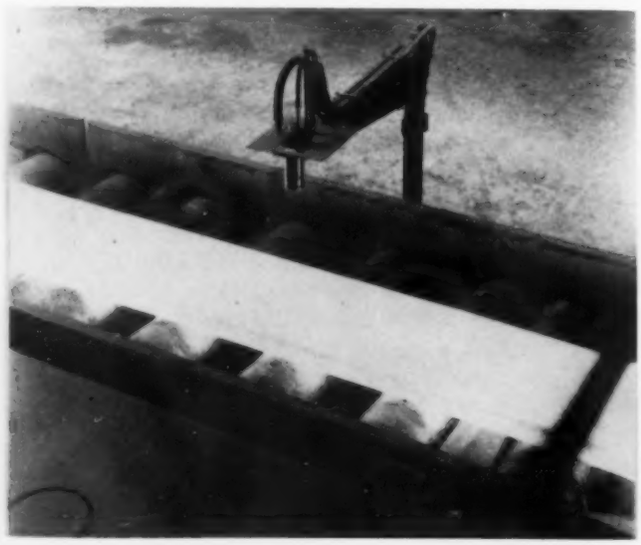
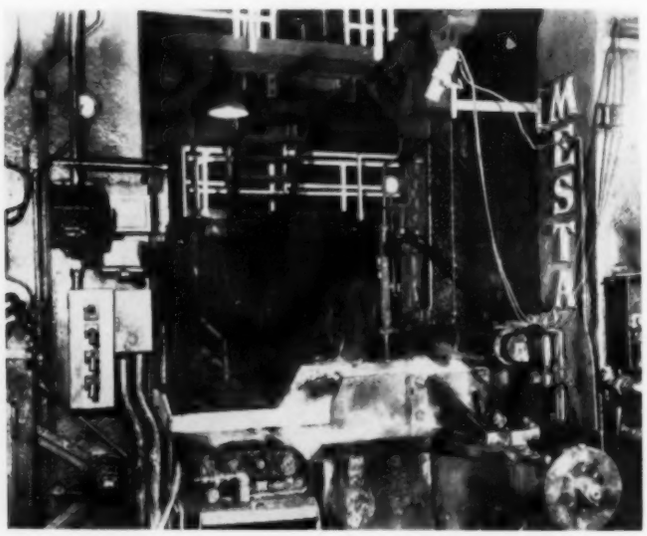


Figure 8 — Radiation pyrometer is located so as to measure the strip temperature just before the last pass.



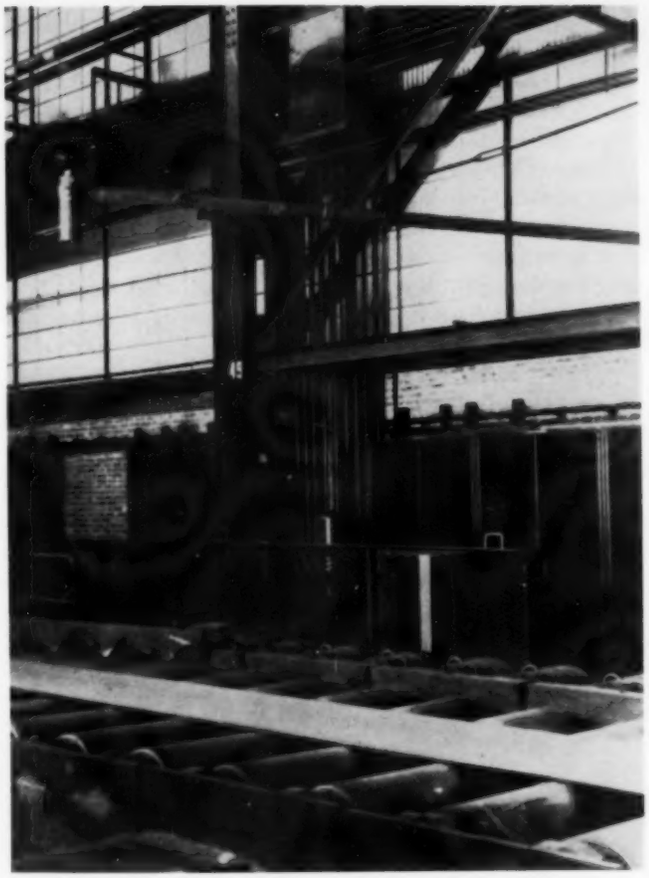


Figure 9 — This radiation pyrometer is mounted over the runout table just ahead of the coilers.

The next temperature is measured as the strip leaves the finishing stands. The radiation pyrometer for this measurement can be located either before or after the last finishing stand. This temperature is recorded at the central temperature station and is also indicated at the assistant roller's desk and up in the finishing mill speed control pulpit to serve as a record for the operating and metallurgical department, and at the same time serve as a guide to the operators in setting proper mill speed, flow of cooling water on rolls, etc. There is some difference of opinion as to whether this temperature should be measured before or after the last finishing stand, but in most installations the location is determined almost entirely by mill conditions, such as the amount of water and steam on the strip and in the atmosphere at the two locations.

The combination of finishing temperature and coiling temperature determines to a great extent the general physical and metallurgical properties of the steel; such as type of finish, hardness, strength, drawing properties, grain size and structure, etc. In the modern mill, the metallurgical department establishes temperature specifications for finishing and coiling each type of steel, and these become a part of the production specs on each order. It is then up to the production department to meet these temperature specifications when rolling the steel and in doing this, the temperature instrumentation becomes their main guide. If the finished product does not meet the customer's specifications for physical properties, the temperature records are consulted to determine whether or not the temperature specifications were met during the various stages of rolling and in this way become a valuable guide in establishing future rolling specifications.

Figure 8 shows a typical installation of the radiation pyrometer between the fifth and sixth stands of the finishing mill measuring the strip temperature just prior to the final pass. The unit is seen at the upper right-hand corner of the picture and it is readily noted that there is a clear sighting path between it and the strip passing through the mill. In the lower left-hand corner of the picture can be seen a steam jet which is located on the fifth stand near the strip to blow water off the strip before the spot at which the tube is sighted. This insures a clean target and an accurate temperature measurement. A jet of air passes through the radiation pyrometer housing down toward the strip and this also helps provide a clear path for the measurement. Note that the arm on which the tube assembly is mounted is free to swing out of its normal position. This type of

Figure 10 — A complete installation of remote temperature indicators gives the operator essential information.

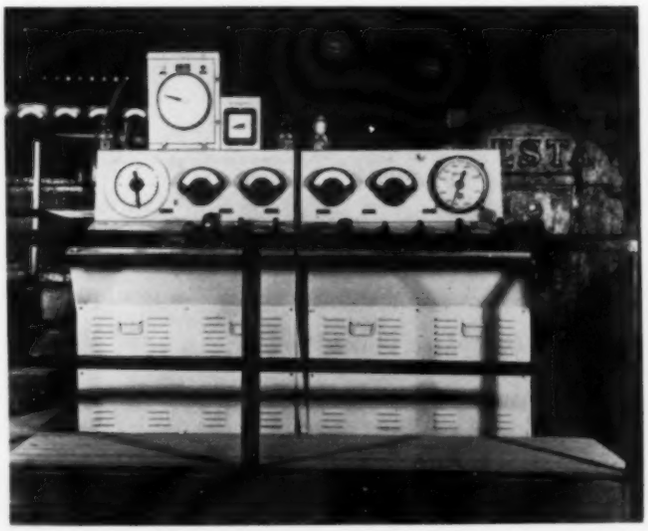
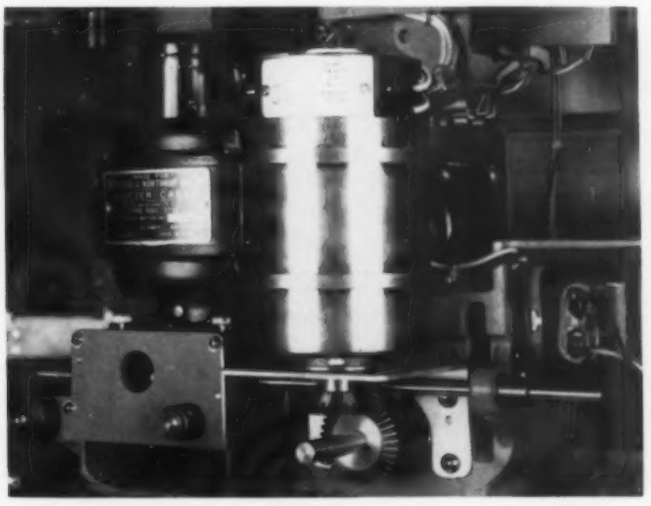


Figure 11 — Photograph illustrates method of mounting and driving transmitter in temperature recorder.



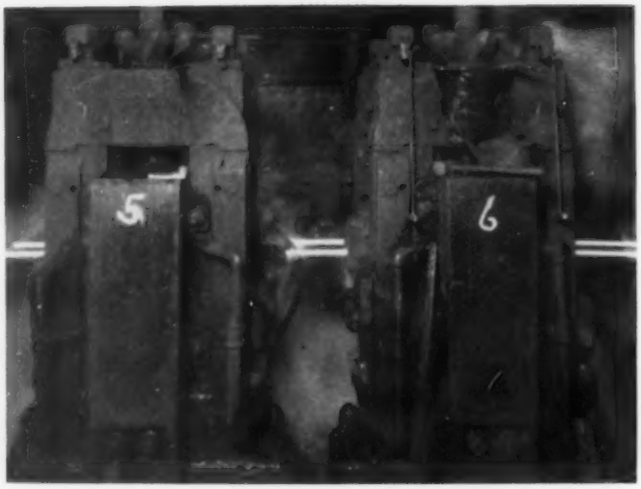


Figure 12 — Pyrometer installation on rod mill.

mounting prevents damage to the unit in the event of a cobble between these stands.

Referring again to Figure 1, we see that from the finishing stand the strip proceeds down the run out tables to the coiler where another very important temperature measurement is made. The temperature of coiling determines to a great extent the final grain size, and, hence, physical properties of the steel and also determines the type of scale formed during the cooling process. In order to obtain the desired grain size and also a type of scale which can be readily removed in later pickling, the metallurgical department specifies proper coiling temperatures. These temperatures are controlled by regulating the water sprays located on the run out table between the finishing stands and the coiler.

Figure 9 shows the mounting of a radiation pyrometer over the run out table just ahead of the coilers. This temperature is recorded back at the central temperature station and is also indicated in the coiler control pulpit or at the assistant roller's desk to serve as a guide to the operation of the water cooling sprays.

Figure 10 shows a complete installation of remote temperature indicators at the crop end shear desk and illustrates how the various rolling temperatures are made available to the operator. At the extreme right-hand side of the desk is seen a self-synchronous type of indicator indicating finishing temperature. The next three indicators of the voltmeter type indicate, respectively, roughing temperature, holding table temperature and coiling temperature.

The voltmeter type of remote indicator is energized from a slidewire located in the temperature recorder. The self-synchronous type of remote indicator is operated from a self-synchronous transmitter located in the temperature recorder.

Figure 11 shows the method of mounting and driving this type of transmitter in the temperature recorder.

As stated previously, we have limited our discussion to temperature instrumentation as applied to the wide hot strip mill. The following figures illustrate some applications to other rolling mills.

Figure 12 shows an installation on a rod mill. Figure 13 shows an installation on a rail mill. Figure 14 shows an installation on a narrow strip mill. Because of the narrow target, the tube must be located close to the strip. Note the rugged protection device located ahead of the tube to protect it from damage due to cobbles.

Figure 13 — Pyrometer installation on rail mill.

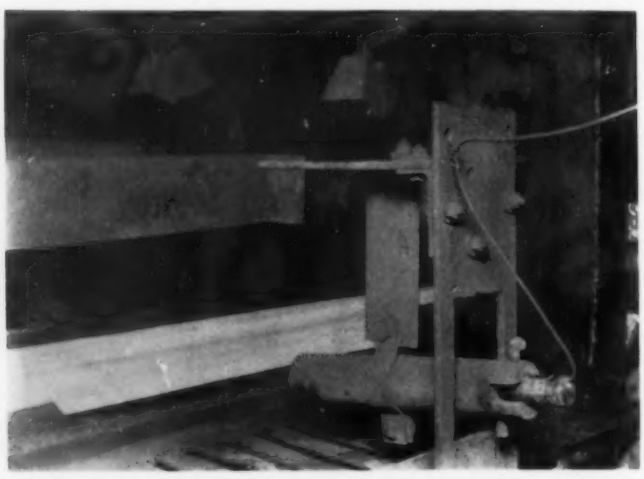


Figure 14 — Pyrometer installation on narrow strip mill.

In the above discussion we have attempted to describe instrumentation that is available for measuring and controlling temperature in the various types of rolling mills. This instrumentation controls temperature in the reheating furnace and records and indicates temperatures along the rolling mill providing a valuable guide for the metallurgical and production departments serving a vital part in the rolling of quality steel product.

DISCUSSION

PRESENTED BY

L. D. TINSLEY, Superintendent, Great Lakes Steel Corp., Ecorse, Mich.

L. D. CULP, Leeds & Northrup Co., Philadelphia, Pa.

L. D. Tinsley: I would like to know if they have

had any difficulty in controlling the top and bottom zone. I noticed in one figure they were controlling both the top and bottom zone with a single instrument.

L. D. Culp: We have experienced some difficulty in controlling the top and bottom zones independently by means of two separate instruments. The close proximity of the two temperature measuring elements results in an interaction between the two controls which makes the overall control somewhat unstable. This problem is solved by paralleling the fuel valves for both zones and controlling them from the top zone recording controller. The bottom zone recorder then serves as a guide to the operator in setting up the paralleling ratio between the top and bottom burners in order to maintain the desired temperatures in both zones.

Member: In Figure 1 you had a temperature control on the pre-heating zone as the slabs come into the furnace, and then you had another control on the heating zone, or top zone; with a temperature differential set up between the two. What approximately is the temperature differential, and in order to avoid overheating, what is the rate of response on re-setting that control temperature in the heating zone, how fast can it control?

L. D. Culp: The temperature differential between the pre-heating zone and top zone controllers will depend upon the relative location of the two measuring elements. On a typical installation this differential was approximately 300 F with the top zone controller set at 2400 F and the preheat zone controller at 2100 F.

The rate of response of automatically resetting the control point on the top zone temperature controller is made fast enough to head off slab temperature increases during mill delays. Actually, this control point can be reset as fast as 100 F in one minute.

Member: Is it fast enough to duplicate a manual control setting? In other words, the heater usually sets the control point down, and I was just wondering if it would match that.

L. D. Culp: The control point is not reset as fast automatically as the heater would reset it manually. However, as soon as the control point starts to move, the proportioning control starts to change the fuel input accordingly. Experience with this control arrangement has shown that during mill delays, the speed of response is rapid enough to prevent any overheating of the slabs which is the primary purpose of the cascade control.

Plan to Attend

1952 ANNUAL AISE CONVENTION

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IRON AND STEEL EXPOSITION

CLEVELAND PUBLIC AUDITORIUM

CLEVELAND, OHIO

SEPTEMBER 30, OCTOBER 1, 2 AND 3

COKE AND BY-PRODUCTS IN 1950

. . . . data from the Mineral Market Reports M.M.S. No. 1991, July 1951; M.M.S. No. 1992, August 1951 and M.M.S. No. 2027, October 17, 1951 . . . .

▲ PRODUCTION of coke in the United States in 1950 increased 14 per cent over the 1949 output according to the Bureau of Mines, United States Department of the Interior. The gain in production would have been greater had all coke ovens available and in workable condition operated at normal rates during the first quarter of the year. However, the 3-day work week and several work stoppages for varying periods in the bituminous coal industry, prior to the negotiation of a new management-labor contract on March 6, 1950, hampered coke-oven operations and reduced the production of coke greatly during the quarter. High consumer demand and the outbreak of war in Korea accelerated requirements for durable goods and, consequently, demand for coke in the metallurgical industries increased rapidly in the latter months of 1950. In response to the enlarged requirements, coke-oven producers stepped up operating rates to capacity levels, and many idle beehive plants were rehabilitated and placed in operation. Production of beehive coke in the last quarter of the year was at a rate in excess of 7,400,000 tons per year.

The rapid increase in coke requirements centered attention on coking capacity and new oven construction. The high operating rate maintained generally in the coke-oven industry since the beginning of World War II has undoubtedly accelerated oven failures. Evidence of this is clearly shown by data collected by the Bureau of Mines from operating companies for the calendar year 1950, which indicated new construction had not offset oven failures but that annual coke capacity of slot-type ovens had actually declined 1,221,900 tons. The volume of new construction in 1950 was limited by shortages of silica brick and other essential construction materials. These shortages must be overcome in order that new coke oven construction can be maintained at a high rate over the next few years to meet anticipated requirements of metallurgical coke. At the close of 1950, 706 new ovens with an annual capacity of 3,992,600 tons were under construction and contracts were pending for a number of additional batteries.

Substantial gains were registered over 1949 in the production of coal chemicals, but the 1950 totals were lower than in 1948. As benzene is the principal raw material for styrene, phenol, and aniline, all vital to the civilian economy and National defense, it has been receiving much attention in government and industry circles. National Production Authority Regulation No. 1, dated September 1950, lists it among the six most critically scarce chemical materials. Coke ovens are our principal source of benzene, but at recent conferences between government and industry representatives, it was generally agreed only minor increases in benzene output could be expected from coke ovens and that production from petroleum would have to be increased rapidly to meet anticipated needs. The heavy demand for benzene stimulated prices, and the average price per gallon of benzene sold by coke-oven operators increased from $0.189 in 1949 to $0.252 in 1950. Prices on other light oil derivatives increased also but ammonium sulfate dropped considerably. The decline in sulfate prices was due chiefly to the expansion of production by synthetic ammonia producers. Total value of coke and breeze produced, and coal-chemical material sold exceeded $1,000,000,000 for the fourth consecutive year, totaling $1,278,947,383.

PRODUCTION OF COKE

In 1950 the average daily rate of by-product coke was 183,000 tons; the average daily production in beehive ovens was 16,000 tons. Leading states in the order of their importance in the manufacture of by-product coke were Pennsylvania, Ohio, Indiana, Alabama, and New York. Alabama just nosed out New York which was in fourth place in 1949, and resumes the position which it has held for a number of previous years. These five states combined produced about 46,148,000 tons or 69.2 per cent of the national production of by-product oven coke. The leading producer of beehive coke was Pennsylvania with 5,193,191 tons or 89 per cent of total beehive production. Of all the coke produced, Pennsylvania was by far the leading producer with 21,526,189 of the total 72,718,038 tons or 29.6 per cent. This was a slight increase from the 27.8 per cent share which Pennsylvania had in 1949.

NUMBER AND CAPACITY OF OVENS

At the end of 1950, there were 14,982 by-product ovens in existence with a total annual capacity of 72,488,200 net tons. This is a slight drop for the second successive year, and compares with 15,104 ovens with an annual capacity of 73,710,100 net tons at the end of 1949. During the year, 696 ovens were abandoned and 574 new ovens with an annual capacity of 3,086,300 tons were put into service. There were 706 ovens with an annual capacity of 3,992,600 tons under construction

as of December 31, 1950. There were 17,708 beehive ovens in existence with an annual capacity of 11,571,500 tons, of which 15,062, with an annual capacity of 9,920,300 tons were in operating condition at the end of the year. About 2038 ovens were rebuilt or repaired during the year, of which all except 18 were located in Pennsylvania. Beehive ovens abandoned during the year totaled 213, and there were 145 under construction at the end of the year.

Although there is a huge coke oven building program underway, the heavy demands on the ovens has resulted in obsolescence at a rate somewhat faster than the construction program. As a result metallurgical coke for blast furnace operation makes it necessary for beehive, merchant and utility coke plants to help meet blast furnace coke requirements. In addition, imports of coke almost doubled in 1950 totaling 437,585 tons compared with 277,507 tons in 1949. Exports on the other hand totaled 397,846 in 1950 compared with 548,256 in 1949. Imports thus exceeded exports in 1950 for the first time since before World War I.

COAL CHARGED INTO COKE OVENS

In 1950, 104,014,695 net tons of coal were charged into coke ovens. Of this, 94,926,310 tons, valued at $822,586,316 or $8.67 a ton were charged into slot type ovens, and 9,088,385 tons valued at $51,769,434 or $5.70 a ton were charged into beehive ovens. Included in this figure are 169,275 tons of anthracite valued at $1,311,021 or $7.74 a ton which were charged into slot type ovens.

The cost of coal (1.42 tons) required to make one ton of by-product coke was $12.31 in 1950. Similarly the cost of coal (1.56 tons) required to make one ton of beehive coke was $8.89 a ton. This is up from the $12.18 and $8.50 a ton in 1949. The trend towards washed coal continues and of the 94,926,310 tons of coal charged into by-product ovens, over 37,792,326 tons were washed compared with 32,647,324 tons which were washed in 1949. The percentage of washed coal is thus 39.9 per cent for by-product ovens. At the beehive ovens, 1,596,836 tons were washed of the 9,088,385 tons charged.

The leading states in the mining of coking coal in order of importance are West Virginia, Pennsylvania, Kentucky and Alabama. Of the 100,880,311 tons of coal produced, West Virginia produced 37,297,646 tons; Pennsylvania, 32,132,219 tons; Kentucky, 13,117,419 tons; and Alabama, the fourth state produced 8,873,356 tons.

COKE PRODUCED AND SOLD OR USED BY PRODUCERS

The total quantity of coke reported used in blast furnaces was 61,039,227 tons or 83.1 per cent of the total. This is higher than the 51,356,617 tons or 81.3 per cent of the total consumed in 1949. The percentage used in blast furnaces thus rose 1.8 per cent. The coke used per net ton of pig iron and ferro-alloys was 1865.5 lb compared with 1895.8 in 1949 thus continuing the down trend of the last three years. Since the yield of coke from coal was 70.5 per cent per net ton of pig iron and ferroalloys, 2646.1 lb of coking coal were used per net ton of iron. The comparable figure of the American Iron and Steel Institute of 1843.1 lb of coke per net ton of pig iron in 1950 excludes the furnaces which make ferroalloys. The total sales of by-product and beehive coke to other than affiliated companies for blast furnace use was 6,941,831 tons. Coke sold for domestic fuel was 2,565,176 tons.

STOCKS OF COKE AND COKING COAL

According to reports of by-product coke plants as of January 1, 1951, stocks of furnace and foundry coke totaled 764,665 tons, domestic and other coke totaled 327,997 tons and the stock of coke breeze was 1,114,662 tons. This is a drop of about 10 per cent in the level of furnace and foundry coke and a drop of about 62 per cent in the level of domestic coke from the previous year. Stocks at beehive oven plants are much less, and coke for furnaces and foundries at these plants totaled 17,952 tons, domestic and other coke totaled 100 tons and stock of coke breeze totals 5253 tons. The coke stock, at beehive plants was thus about one-third that of the previous year and this drop is even more significant when the fact is taken into account that the number of beehive ovens increased appreciably during the year.

As a result of the labor disturbances in the coal mining industry in the first part of 1950, coal stocks dropped markedly from a high during the year in January 1950 of 1,280,984 tons to a low in March of 549,897 tons. With the signing of a new labor contract on March 6, 1950, stock began to rise and by the end of the year had recovered to about 1,100,000 tons.

GROSS VALUE IN YIELD OF BY-PRODUCTS

The gross value of by-products sold in 1950, but exclusive of the value of tar used by the producer and the value of coke breeze produced, and including the value of the surplus gas sold was $274,692,471 or 28.2 per cent of $976,913,202 (the gross value of the coke produced). Average value of coke, breeze and coal-chemical materials was $17.96 per ton coke consisting of $4.24, $0.27 and $13.45 for each of these three materials respectively. The average yield of the primary coke products was about the same in 1950 as in 1949. In 1950 the average yield of tar decreased slightly from 7.81 to 7.79 gal per ton of coal; ammonium sulfate or equivalent decreased from 20.08 to 19.89 lb per ton, crude light oil increased from 2.77 to 2.81 gal per ton, and the average yield of gas increased from 10.25 to 10.32 M cu ft per ton.

DISTRIBUTION OF OVEN AND BEEHIVE COKE

The 14 per cent increase in coke output in 1950 over 1949 resulted in a corresponding increase in the quantity of coke which was distributed. The total movement of coke was 73,373,618 tons. Beehive ovens were an important factor in the increase of coke product, and the proportion of coke furnished by beehive ovens rose from

TABLE I

Statistical Trends of the Coke Industry in the United States

	1937	1947	1948	1949	1950
Production:					
Oven coke, net tons	49,210,748	66,758,549	68,284,357	60,222,481	66,890,618
Beehive coke, net tons	3,164,721	6,687,301	6,577,571	3,414,948	5,827,420
Total, net tons	52,375,469	73,445,850	74,861,928	63,637,429	72,718,038
Per cent oven coke	94.0	90.9	91.2	94.6	91.8
Stocks of coke, end of year, net tons	2,595,287	1,032,237	1,593,441	1,769,456	1,110,714
Exports, all coke, net tons	526,683	835,059	706,190	548,256	397,846
Imports, all coke, net tons	286,364	104,093	161,400	277,507	437,585
Indicated consumption, all coke, net tons	51,271,929	72,611,413	73,755,934	63,190,665	73,416,519
Disposal, all coke sold or used:					
Furnace coke, net tons	36,751,969	57,636,505	59,285,506	51,514,853	60,918,549
Foundry coke, net tons	2,038,822	3,650,001	3,750,659	2,778,868	3,523,396
Other industrial coke (including producer and water gas), net tons	4,597,894	8,028,791	7,733,382	6,412,672	6,366,497
Domestic coke, net tons	8,107,518	3,977,328	3,445,309	2,755,840	2,565,176
Carbonizing equipment:					
By-product ovens in existence, end of year	12,718	14,728	15,139	15,104	14,982
Beehive ovens in existence, end of year	12,194	13,443	14,078	13,662	17,708
By-product ovens under construction, end of year	259	572	350	562	706
Cost of coal charged, oven-coke plants, average per ton	$3.74	$6.78	$8.13	$8.52	$8.67
Prices of coke:					
Average spot price of Connellsville furnace coke, fob ovens	$4.29	$10.49	$13.44	$13.77	$14.06
Average realization on oven coke sold (merchant sales):					
Furnace coke	$4.34	$10.95	$13.78	$14.09	$14.31
Foundry coke	$8.47	$14.79	$18.78	$19.72	$20.05
Other industrial coke (including water gas)	$6.08	$11.13	$13.45	$13.74	$14.10
Domestic coke	$6.53	$11.19	$13.17	$13.50	$13.60
Yield of by-products per ton of coal charged:					
Tar, gal	8.67	7.78	7.60	7.81	7.79
Ammonium sulphate or equipment, lb	21.84	19.66	19.52	20.08	19.89
Crude light oil, gal	2.86	2.75	2.73	2.77	2.81
Surplus gas sold or used, M cu ft	6.66	6.27	6.25	6.35	6.36
Average gross receipts for by-products, per ton of coke produced:					
Tar sold and used	$0.502	$0.605	$0.828	$0.722	$0.691
Ammonia and its compounds	$0.326	$0.423	$0.545	$0.558	$0.468
Crude light oil and its derivatives (including naphthalene)	$0.435	$0.566	$0.685	$0.673	$0.873
Surplus gas sold or used	$1.483	$1.678	$1.839	$2.015	$1.977
Total coal-chemical materials (including breeze)	$2.974	$3.710	$4.419	$4.447	$4.513

the 5.4 per cent furnished in 1949 to 8 per cent in 1950. Coke was distributed to every state in the union varying from a low of 48 tons in the District of Columbia to a high of 19,468,791 in Pennsylvania.

The upward trend in coke requirements for metallurgical uses continues and 83.1 per cent of all coke consumed in 1950 was used in iron furnaces. This compares with 81.3 per cent in 1949 and 73.3 per cent in 1937. By-product oven coke used in blast furnaces totaled 55,661,298 tons in 1950 compared with 48,653,821 tons in 1949. By-product coke used in foundries totaled 3,236,218 tons in 1950 compared with 2,498,593 tons in 1949. By-product coke used for other industrial uses including water gas declined from 3,634,465 tons in 1949 to 3,385,133 tons in 1950. Practically all of the coke produced in the beehive ovens was used in blast furnaces, the total being 5,257,251 tons or 90.2 per cent. Of the balance, 184,178 tons was used in foundries and 298,940 tons went to other industrial uses including water gas.

CONSUMPTION BY STATES

As usual, Pennsylvania, which leads in blast furnace capacity was the leading coke consuming state and used about 27 per cent of the national total. Ohio was second using 16 per cent, and was followed by Indiana with 10 per cent, and by New York and Illinois with 8 per cent each, and Alabama with 7 per cent. Other states which used over 2,000,000 tons were Maryland, Michigan and West Virginia, and these three states together used about 11 per cent of the total. Blast furnace coke was used in 21 states in 1950, and Pennsylvania accounted for 30 per cent of the total, which is the same percentage as in 1949. Blast furnaces in Ohio used 18 per cent, in Indiana used 11 per cent, in Illinois used 8 per cent, in Alabama used 8 per cent, in New York used 6 per cent, in Maryland used 5 per cent and West Virginia used 3 per cent, thus these 8 states used 89 per cent of the total blast furnace coke used in the United States. Foundry coke usage is spread pretty evenly throughout the country, and Michigan leads all the states with 652,238 tons or 19 per cent of the total. The next leading users of foundry coke are Ohio, Pennsylvania and Illinois using 387,161; 377,726 and 303,583 tons respectively. Of the 25 states using coke to make water gas, New York leads with 1,098,758 tons or 34 per cent of the total. New York also leads as a user of coke for producer gas using 280,683 tons or 37 per cent of the total.

EFFECT OF NATURAL GAS

The increased construction of natural gas distribution systems with the consequent increase in the amount of

TABLE II

Salient Statistics of the Coke Industry in the United States in 1950

		By-product	Beehive ovens	Total
Coke produced — At merchant plants	net tons	12,346,822	.....	.....
At furnace plants	net tons	54,543,796	(1)	.....
Total	net tons	66,890,618	5,827,420	72,718,038
Screenings or breeze produced	net tons	5,172,758	90,712	5,263,470
Coal charged into ovens	net tons	94,926,310	9,088,385	104,014,695
Average value of coal per ton		$8.67	$5.70	$8.41
Average yield in per cent of total coal charged —				
Coke		70.47	64.12	69.91
Breeze (at plants actually recovering)		5.45	3.32	5.06
Ovens — In existence January 1		15,104	13,662	28,766
In existence December 31		14,982	17,708	32,690
Dismantled during year		696	213	909
In course of construction December 31		706	145	851
Annual coke capacity December 31	net tons	72,488,200	11,571,500	84,059,700
Coke used by producer — In blast furnaces	net tons	40,728,294	67,434	40,795,728
In foundries	net tons	103,000	.....	103,000
To make producer gas	net tons	755,849	.....	755,849
To make water gas	net tons	1,501,979	.....	1,501,979
For other purposes	net tons	321,864	2,732	324,596
Coke sold — To financially affiliated companies —				
For blast furnace use	net tons	11,342,443	1,838,547	13,180,990
For foundry use	net tons	53,530	.....	53,530
For manufacture of water gas	net tons	695,852	.....	695,852
For other purposes	net tons	161,344	1,871	163,215
To other consumers —				
For blast furnace use	net tons	3,590,561	3,351,270	6,941,831
For foundry use	net tons	3,182,688	184,178	3,366,866
For manufacture of water gas	net tons	929,463	40,514	969,977
For other industrial use	net tons	1,598,474	356,555	1,955,029
For domestic use	net tons	2,546,164	19,012	2,565,176
Disposal of screenings or breeze —				
Used by producer — For steam	net tons	3,353,357	5,408	3,358,765
To make producer or water gas	net tons	113,158	.....	113,158
For other purposes	net tons	797,435	11	797,446
Sold	net tons	1,407,041	50,120	1,457,161
Average receipts per ton sold (merchant sales)				
Furnace coke		$14.31	$13.56	$13.95
Foundry coke		$20.05	$15.01	$19.78
Water-gas coke		$15.07	$13.97	$15.02
Other industrial coke		$13.54	$13.61	$13.55
Domestic coke		$13.60	$11.84	$13.59
Screenings or breeze		$3.92	$2.10	$3.86
Stocks on January 1, 1951:				
Furnace coke	net tons	756,199	17,068	773,267
Foundry coke	net tons	8,466	884	9,350
Domestic and other coke	net tons	327,997	100	328,097
Screenings or breeze	net tons	1,114,662	5,253	1,119,915
Exports	net tons	(1)	(1)	397,846
Imports	net tons	(1)	(1)	437,585
Indicated consumption	net tons	(1)	(1)	73,416,519
By-products produced — Tar	gal	739,868,767	.....	739,868,767
Ammonium sulphate or equivalent	lb	1,849,127,582	.....	1,849,127,582
Gas	M cu ft	979,592,988	.....	979,592,988
Burned in coking process	per cent	36.81	.....	36.81
Surplus sold or used	per cent	61.54	.....	61.54
Wasted	per cent	1.65	.....	1.65
Crude light oil	gal	260,856,875	.....	260,856,875
Yield of by-products per ton of coal —				
Tar	gal	7.79	.....	7.79
Ammonium sulphate or equivalent	lb	19.89	.....	19.89
Gas	M cu ft	10.32	.....	10.32
Crude light oil	gal	2.81	.....	2.81
Coal used per ton of coke	tons	1.42	1.56	1.43
Value of coke at ovens		$899,677,327	$77,235,875	$976,913,202
Value of screenings or breeze		$18,543,877	$144,629	$18,688,506
Value of by-products sold — Tar sold		$37,558,999	.....	$37,558,999
Used by producer		$8,663,204	.....	$8,663,204
Ammonia (sulphate and liquor)		$31,322,588	.....	$31,322,588
Gas (surplus)		$132,247,656	.....	$132,247,656
Crude light oil and derivatives		$53,943,017	.....	$53,943,017
Other coal-chemical materials (2)		$19,620,211	.....	$19,620,211
Total value of coke and breeze produced and coal-chemical materials sold (3)		$1,201,566,879	$77,380,504	$1,278,947,383

(1) Not separately recorded. (2) Naphthalene, tar derivatives, and miscellaneous coal-chemical materials.
(3) Includes value of tar used by producer.

TABLE III

Coke produced, value, number of ovens, coal charged, and average yield in the United States in 1950, by States

(Exclusive of screenings or breeze)

State	Oven coke						
	Plants	Ovens	Coal charged (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Alabama	7	1,311	8,221,235	70.95	5,833,142	$64,331,998	$11.03
California	1	135	846,247	60.60	512,790	(1)	(1)
Colorado	1	266	1,181,658	68.12	804,979	(1)	(1)
Illinois	8	900	5,123,840	70.07	3,590,502	58,141,266	16.19
Indiana	5	1,801	11,201,317	73.70	8,255,622	138,880,962	16.82
Maryland	1	488	3,300,510	71.72	2,367,233	(1)	(1)
Massachusetts	1	204	1,193,968	71.63	855,217	(1)	(1)
Michigan	4	584	3,722,106	73.37	2,730,847	39,191,757	14.35
Minnesota	3	273	1,145,826	72.77	833,861	13,030,429	15.63
New Jersey	2	341	2,061,953	71.83	1,481,030	(1)	(1)
New York	8	1,136	7,877,787	68.70	5,412,318	73,459,620	13.57
Ohio	15	2,310	14,692,413	70.20	10,313,767	130,016,706	12.61
Pennsylvania	13	3,636	23,641,930	69.08	16,332,998	201,135,604	12.31
Tennessee	1	44	332,439	73.38	243,950	(1)	(1)
Texas	2	125	961,312	71.40	686,407	(1)	(1)
Utah	2	285	1,779,485	64.10	1,140,737	(1)	(1)
West Virginia	5	644	4,775,747	70.96	3,388,626	36,457,582	10.76
Connecticut Kentucky, Missouri, Rhode Island, and Wisconsin	6	499	2,866,537	73.49	2,106,592	31,876,236	15.13
Undistributed	..	.....	.....	.....	.....	113,145,167	13.98
Total 1950	85	14,982	94,926,310	70.47	66,890,618	899,667,327	13.45
At merchant plants	30	3,036	17,232,762	71.65	12,346,822	190,570,598	15.43
At furnace plants	55	11,946	77,693,548	70.20	54,543,796	709,096,729	13.00
Total 1949	85	15,104	86,054,401	69.98	60,222,481	798,792,069	13.26

State	Beehive coke						Total	
	Ovens	Coal charged (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
					Total	Per ton		
Alabama	.....	.....	.....	.....	.....	.....	5,833,142	$64,331,998
California	.....	.....	.....	.....	.....	.....	512,790	(1)
Colorado	.....	.....	.....	.....	.....	.....	804,979	(1)
Illinois	.....	.....	.....	.....	.....	.....	3,590,502	58,141,266
Indiana	.....	.....	.....	.....	.....	.....	8,255,622	138,880,962
Maryland	.....	.....	.....	.....	.....	.....	2,367,233	(1)
Massachusetts	.....	.....	.....	.....	.....	.....	855,217	(1)
Michigan	.....	.....	.....	.....	.....	.....	2,730,847	39,191,757
Minnesota	.....	.....	.....	.....	.....	.....	833,861	13,030,429
New Jersey	.....	.....	.....	.....	.....	.....	1,481,030	(1)
New York	.....	.....	.....	.....	.....	.....	5,412,318	73,459,620
Ohio	.....	.....	.....	.....	.....	.....	10,313,767	130,016,706
Pennsylvania	14,954	8,061,544	64.42	5,193,191	$68,086,247	$13.11	21,526,189	269,221,851
Tennessee	.....	.....	.....	.....	.....	.....	243,950	(1)
Texas	.....	.....	.....	.....	.....	.....	686,407	(1)
Utah	797	155,301	54.61	84,808	(1)	(1)	1,225,545	(1)
Virginia	750	322,849	61.29	197,879	2,930,883	14.81	197,879	2,930,883
West Virginia	1,012	482,976	62.59	302,309	4,307,719	14.25	3,690,935	40,765,301
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	195	65,715	74.92	49,233	(1)	(1)	2,155,825	(1)
Undistributed	.....	.....	.....	.....	1,911,026	14.37	.....	146,932,429
Total: 1950	17,708	9,088,385	64.12	5,827,420	77,235,875	13.25	72,718,038	976,903,202
1949	13,662	5,354,495	63.78	3,414,948	43,945,627	12.87	63,637,429	842,737,696

(1) Included with "Undistributed."

natural gas marketed is having a definite effect on the production of coke oven gas particularly for domestic and some industrial users. Marketed production of natural gas increased to 6,282,060,000,000 cu ft in 1950 from 5,419,736,000,000 in 1949. Most producing states showed gains, the largest being made in Texas, Louisiana, and Kansas. Marketed production in Mississippi increased 68 per cent, and Maryland for the first time produced marketable quantities of natural gas.

The gross quantity of gas placed in underground storage in 1950 was 229,752,000,000 cu ft compared with 172,051,000,000 in 1949. The net increase in gas in

TABLE IV

Coal-Chemical Materials Obtained from Coke-Oven Operations in the United States in 1950 (1)

(Exclusive of Screenings or Breeze)

Product		Produced	Sold			On hand Dec. 31
			Quantity	Value		
				Total	Average	
Tar	gal	739,868,767	435,245,843	$37,558,999	$0.086	30,138,144
Tar derivatives:						
Creosote oil, distillate as such	gal	20,713,726	20,658,909	4,171,298	0.202	348,126
Creosote oil, in coal-tar solution	gal	12,265,165	9,493,322	1,480,067	0.156	586,019
Tar acid oil	gal	17,710,589	17,967,300	4,278,414	0.238	540,737
Phenol	lb	7,939,303	7,942,406	947,147	0.119	200,896
Pitch of tar:						
Soft (2)	net tons	432,580	7,155	249,457	34.865	9,677
Hard (3)	net tons	283,131	17,347	312,010	17.986	2,991
Other tar derivatives (4)		.....	.....	1,076,198	.....	.....
Ammonia:						
Sulfate:						
From coke-oven ammonia	lb	1,662,032,906	1,682,331,655	29,755,089	0.018	115,377,093
From purchased synthetic ammonia	lb	29,397,962	29,497,962	661,817	0.022	.....
Liquor (NH_3 content)	lb	46,773,669	43,162,889	1,567,499	0.036	1,273,501
				(5)31,322,588		
Sulfate equivalent of all forms	lb	1,849,128,582	1,854,983,211	.....	.....	120,471,097
NH_3 equivalent of all forms	lb	462,281,895	463,745,803	.....	.....	30,117,774
Gas:						
Used under boilers, etc	M cu ft	(7)979,592,988	35,856,065	4,440,208	0.124	.....
Used in steel or allied plants	M cu ft		378,271,394	65,091,633	0.172	.....
Distributed through city mains	M cu ft		149,429,729	56,504,724	0.378	.....
Sold for industrial use	M cu ft		39,258,789	6,211,091	0.158	.....
		(7)979,592,988	602,815,977	132,247,656	0.219	.....
Crude light oil	gal	(8)260,856,875	19,663,139	2,873,773	0.146	4,866,091
Light oil derivatives:						
Benzol:						
Motor	gal	7,727,349	7,588,602	1,437,199	0.189	477,281
All other grades	gal	154,466,388	150,957,388	38,513,419	0.255	5,459,041
Toluol, crude and refined	gal	30,664,831	30,417,947	7,319,842	0.241	972,156
Xylol, crude and refined	gal	8,066,942	7,982,296	2,089,914	0.262	487,453
Solvent naphtha	gal	6,002,849	5,785,188	1,133,502	0.196	390,046
Other light oil products	gal	6,818,021	4,096,921	451,814	0.110	375,378
		213,746,380	206,828,342	50,945,690	0.246	8,161,355
Intermediate light oil	gal	856,192	826,861	123,554	0.149	58,177
Naphthalene, crude	lb	99,729,587	106,865,795	4,425,894	0.041	4,242,254
Pyridine:						
Crude bases (dry basis)	gal	427,507	415,480	525,450	1.265	104,835
Refined, or 2C	lb	1,170,998	1,198,377	951,206	0.794	28,820
Sodium phenolate	gal	2,743,047	2,617,982	413,567	0.158	265,263
Sulfur	lb	5,858,015	7,554,535	116,172	0.015	1,463,290
Other coal-chemical materials (9)		.....	.....	549,777	.....	.....
Value of all coal-chemical materials sold		.....	.....	274,568,917	.....	.....

(1) Includes products of tar distillation conducted by coke-oven operators under same corporate name. (2) Softening point less than 110 F. Includes some medium pitch-of-tar reported by 2 producers. (3) Softening point over 160 F. (4) Cresols, cresylic acid, fuel oil, pitch coke, refined tar, and tar paint. (5) Excludes value of sulfate from purchased synthetic ammonia. (7) Includes gas used for heating ovens and gas wasted. (8) 244,872,337 gallons refined by coke-oven operators to make derived products shown. (9) Ammonium thiocyanate, picolines, and sodium prussiate.

underground storage during 1950 was 59,492,000,000 cu ft.

Total consumption of natural gas in 1950 increased to 6,026,404,000,000 cu ft from 5,195,484,000,000 in 1949. All consuming states reported increases; Texas, Ohio, and California showed the largest gains. The quantities consumed by various classes of consumers in 1950 and the per cent change compared with 1949 are as follows: residential, 1,198,369,000,000 cu ft, plus 21 per cent; commercial, 387,838, plus 12 per cent; field, 1,187,473, plus 12 per cent; petroleum refineries, 455,096, plus 8 per cent; other industrial, 2,797,628, plus 18 per cent.

The total value at the well of marketed production was $408,776,000, averaging 6.5 cents per thousand cu ft compared with 6.3 cents in 1949. The total value at point of consumption of all natural gas used in 1950 in the United States was $1,597,930,000, averaging 26.5 cents per thousand cu ft.

Interstate shipments and exports of natural gas increased 27 per cent to 2,543,538,000,000 cu ft in 1950. Texas, Louisiana, and Oklahoma each shipped over 40 per cent of their marketed production out of the state.

Conversion of Filters

TO ZEOLITE SOFTENERS

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. . . . paper presented before 1951 Midwest Power Conference, April 4, 1951 at Chicago, Illinois . . . . paper outlines one way of meeting the soda ash shortage . . . .

▲ THE vital importance of steam generation to the steel industry is not difficult to visualize. Not so widely realized, however, is the tremendous quantity of steam generated by a typical steel mill power plant. For example, at one plant of United States Steel Co., approximately 2,000,000 lb of steam per hr are generated at pressures of 150 to 600 psi. The necessity for dependable boiler feedwater treatment is magnified by high makeup rates which impose treated water requirements of 3,500,000 gal per day.

Soda ash plays an essential role in steel production because it is used in huge quantities for softening boiler feedwater at many mills. At the single plant already mentioned, this material is consumed at a typical rate of 4500 lb per day. Few people were aware of the serious threat to steel production which occurred in the summer of 1950 due to strikes at plants of the chief producers of soda ash.

These strikes had reduced the company's total soda ash supplies to 25 per cent of normal by August. Although some soda ash was still being obtained, it was impossible to balance consumption to the low receipts. Complete disappearance of stocks was dangerously near. Due to the seriousness of the situation it was necessary to make plans either to: (1) shut down boilers before soda ash stocks were completely gone in order to preserve boilers in good condition, or (2) operate the boilers without soda ash until shutdown was forced. The first alternative was decided upon because it was believed that operating without soda ash for any length of time would so damage boilers that total outage time in the long run would be greater.

However, full production of steel was maintained at all United States Steel Co. plants despite the fact that receipts of soda ash continued to be so small that widespread curtailment of operations would normally have been necessary. The story of the action taken to maintain an adequate supply of treated water during this period is told as an example of how American industry handles emergency situations to maintain a high level of production.

By August 11, stocks of soda ash in some of the plants were practically exhausted, and at other plants would last less than 30 days. That was the discouraging picture when our feedwater treating consultants suggested a plan of treatment which would reduce soda ash consumption by about 85 per cent at certain plants. This appealing suggestion was explored thoroughly. While the plan admittedly was expensive and likely to involve operating difficulties, it was basically sound. The fact that it would save soda ash made any other objections of relatively minor importance. The plan was approved and materials ordered in less than three days—and these three days included a week-end.

The proposed project was particularly suited to the plants having cold process batch-type lime-soda ash softening systems. Since these plants consume large quantities of soda ash, the adoption of the new system would free sufficient soda ash to enable normal operation of hot-process continuous softeners at other plants. Soda ash consumption could thus be balanced to the limited receipts and full production at all plants assured.

Basically, the plan was to replace the sand in the open filter beds of the cold process plants with an ion exchange mineral, operating these beds as softeners as well as filters. The batch type lime-soda ash softeners were to be operated as clarifiers only, using no soda ash. The only soda ash required was to be a small amount fed directly to the boilers to maintain proper boiler

water alkalinities. The fact that the low alkalinity, high sulphate raw water used is suitable for either lime-soda ash or zeolite softening made such a conversion possible. While this general system—clarification followed by ion exchange—is regularly used in some plants, it normally includes filters before the ion exchangers and utilizes equipment especially designed for ion exchange.

Two methods of approach were open. The first was to conduct extensive experiments with the new system on laboratory or pilot plant scale, gathering information which would enable initiation of the unusual treating plan under optimum mechanical and operating conditions. The second method was to start the system on a plant scale basis, solving the operating problems as they developed. The second method was chosen for three reasons:

1. It would save large amounts of critical soda ash at once.
2. It would furnish valuable experience in operating this type of system which would enable its extension to other plants at the earliest possible date.
3. Previous experience of our consultants with combination precipitation—ion exchange softening gave adequate assurance that the proposed system would work successfully.

TABLE I

TYPICAL WATER ANALYSIS DURING ZEOLITE OPERATION

(All Results in PPM)

	Raw plant system	Clarified	Zeolite softened	Boiler
Dissolved solids	405	410	400	5350
Total hardness (as $CaCO_3$)	226	214	5	0
Calcium hardness (as $CaCO_3$)	164	154	3	0
Magnesium hardness (as $CaCO_3$)	62	60	2	0
Phenolphthalein alk (as $CaCO_3$)	0	0	0	235
Hydroxides (as $CaCO_3$)	0	0	0	130
Total alkalinity (as $CaCO_3$)	7	19	20	340
Free CO_2 (as $CaCO_3$)	8	2	0	0
Chloride (as NaCl)	22	22	28	340
Sulphate (as Na_2SO_4)	360	312	318	3850
Silica (as SiO_2)	8	5	6	65
Iron (as Fe)	2.6	0.2	0.1	...
Alumina (as Al_2O_3)	1.0	0.1	0.2	2.6
pH	6.5	7.8	8.1	...
Phosphate (as PO_4)	...	....	....	35
Sulphite (as SO_3)	...	....	....	24

It was decided to make the first conversion at a large plant where soda ash consumption was high and consequently the most benefit could be gained. A line diagram of the existing treating system at the plant selected is shown in Figure 1.

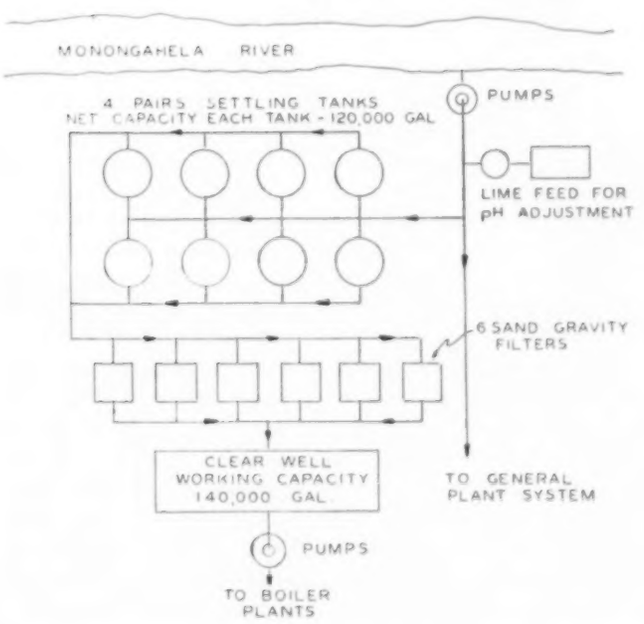
The Monongahela River water used at this plant is high in sulphate hardness and turbidity, and has a very low and variable pH due to pollution with acid mine drainage. It is treated with lime to adjust the pH to about 6.5 to reduce its corrosivity when used for plant service. For boiler feed use, this pH-adjusted water is softened in batch type cold-process lime-soda ash softeners. Eight tanks, each with an effective capacity of 120,000 gal, are operated in pairs. After settling, the softened water is filtered through six open sand filters operating in parallel. The filtered water is retained in a clear well having a capacity of 140,000 gal, or about a one and one-half hour supply. From there it is pumped to the boiler houses where after-treatment is applied. Eighteen boilers are operated at 250 psi with 100 per cent make-up, one boiler is operated at 600 psi with 20 per cent make-up, and one boiler at 600 psi with one per cent evaporated make-up. Total evaporation is 1,600,000 pounds per hour. Treated water make-up averages 2,200,000 gallons per day.

Typical sulphate hardnesses of the Monongahela River water are between 85 and 250 parts per million, requiring one to three pounds of soda ash per 1000 gal of water. Typical pH values are between 4.0 and 6.0.

The three main obstacles to be met in converting this plant to zeolite operation were: (1) overcoming the obvious mechanical shortcomings, for ion exchange, of a system designed merely for filtration, (2) training personnel in a very short time to operate a system foreign to them, and (3) maintaining uninterrupted, maximum steam production at all times. The mechanical shortcomings of the system were many:

1. The filters were too shallow to permit adequate freeboard, supporting gravel depth, and zeolite bed depth. Only 10 in. could be used for freeboard, 9 in. for supporting gravel, and 20 in. for zeolite mineral. This compares with the normally recommended zeolite bed depth of at least 30 in.
2. The collection piping was unconventional for zeolite operation.
3. Dead space under the bottom collection piping prevented down-flow regeneration which is normally used.
4. Backwash water pressure was undependable.
5. No brining or salt distribution facilities were available.
6. The condition of the underdrain piping was questionable. This would have been reconditioned before starting the new operation, but urgency

Figure 1 — Line diagram of water treating plant.



dictated that this condition be taken as a calculated risk to permit making the conversion as rapidly as possible.

The selection of the proper exchange mineral was essential. Four types of materials were available—greensand, carbonaceous zeolite, high capacity resins, and synthetic siliceous zeolites. The mineral had to have: (1) sufficient density to prevent excessive loss of mineral during backwashing, (2) approximately the same resistance to flow as sand so that the flow rates would be adequate, (3) capacity sufficiently high to handle make-up requirements, and (4) stability under the conditions of temperature and pH to be encountered.

Under the conditions at this plant, greensand was considered to be too low in capacity; carbonaceous zeolite, too low in capacity and density; high capacity resins, too low in density. A synthetic siliceous type was selected because it suited best the overall requirements. Its capacity was specified at 10,000 gr per cu ft with a salt rate of six lb per cu ft.

Figure 2 shows details of one of the filters after conversion to a softener. The only change made in the filters was the substitution of zeolite for the sand and some of the fine gravel. About 220 cu ft of mineral were used in each unit. The water collecting troughs above the beds, and the air and water distribution systems below the beds remained the same. Even the lower gravel beds were not disturbed. The beds were bypassed until the conversion of five units was completed, so that operation of the plant was not interrupted. The sixth unit was not converted or operated at the start.

On August 25, just two weeks after the idea was conceived, this plant started "Operation Zeolite."

Briefly the new system operated as follows:

1. Monongahela River water, with pH adjusted to about 6.5 with lime, was pumped to the batch type lime-soda ash softening tanks. As the tanks filled, lime was added to adjust pH of the water to the level desired for best coagulation. Solutions of coagulating chemicals were pumped into the tank after lime addition. Agitation, provided by paddles in the bottom of the 120,000-gallon capacity tanks, was continued until the tanks were filled. After a settling period of four to five hours, water was drawn off from the surface and fed by gravity to the filter-softeners.
2. The filter-softeners were operated downflow. When exhausted, they were backwashed upflow. Then, with about 10 in. of water over the bed, granulated salt was manually distributed over the bed and dissolved in the water with air agitation from beneath the bed. The brine solution was lowered into the bed and agitation continued. After regeneration, the beds were rinsed upflow and returned to service. The salt rate was six lb per cu ft of zeolite.

Service engineers representing our feedwater treating consultants were on hand from the start. They arranged to provide supervision around the clock until the operation had smoothed out and operators could handle the new treating and control procedures as a routine matter.

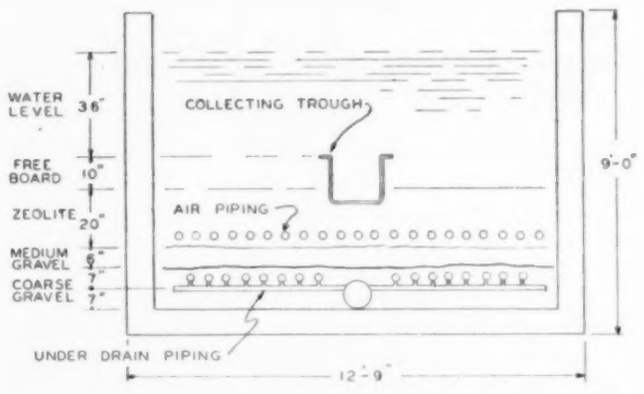
Almost as soon as operations began shortly before midnight on August 25, it was apparent that some of the anticipated difficulties would occur sooner and in more serious form than expected. The softeners were removing hardness satisfactorily so that the quality of the boiler make-up water was good, but it was becoming increasingly difficult to keep a sufficient reserve of softened water in the clear well because of reduced flow rate through the beds. When the level in the clear well drops below three feet, raw water must be added to assure a supply for the boilers. This danger point was rapidly being reached.

The insufficient flow rate was ascribed to packing of the zeolite due to trampling of the beds during conversion. This condition was aggravated by poor distribution of air and water from the underdrain systems, which were later found to be fouled to a much greater extent than originally believed. Throughout the first night, beds were being desperately backwashed and stirred up manually with hoes and rakes in a continuous struggle to maintain clear well level. Fortunately, one of the beds delivered an exceptional amount of excellent quality water. This one long run, during which the mineral showed an apparent capacity of close to 15,000 gr per cu ft, provided a narrow margin of safety throughout the night. This inspired belief in the eventual success of the project as soon as all beds could be put in good condition.

Originally it was planned to start regenerating softeners one at a time as soon as operation started, thus staggering the times at which the beds would exhaust and again be regenerated. However, this procedure was not possible because of the initial difficulty in freeing and back-washing the beds. For this reason it seemed probable that a number of the beds would exhaust at the same time the next morning. Since the low flow rates made it impossible to maintain adequate clear well level with more than one bed off the line for regeneration at the same time, it was expected that it would then be necessary to abandon the project temporarily because of high hardness from the exhausted beds.

In a meeting of the top supervision of the power and fuel division and engineers of our water treating consultants, it was decided to treat two tanks with normal lime-soda ash dosages. When effluent from the zeolite beds became too poor in quality, this water was to be fed directly to the boilers until all zeolite beds could be loosened, backwashed, and regenerated so that a fresh start could be made. However, the day passed without the necessity for using the lime-soda ash treated water. Due to improvement in zeolite operation, holding these

Figure 2 — Sectional view of original design of filters as converted to zeolite softeners.



tanks in reserve was no longer believed necessary and they were fed to the boilers.

Dumping of these tanks was prompted also by the development of another serious problem—poor coagulation and settling in the clarifiers. Emptying the tanks held in reserve permitted operation of all eight tanks as clarifiers, thus allowing longer settling time. Attention was now shifted to improving coagulation to avoid putting a heavy filtering load on the zeolite beds.

At the start, sodium aluminate at the rate of 10 ppm and ferrous sulphate at the rate of 15 ppm were being used as coagulants, together with lime to adjust clarifier effluent pH to about 7.0. Coagulation and settling were only fair at best, and the zeolite beds were apparently becoming clogged with suspended solids and iron. To prevent iron-fouling of the mineral, and in an attempt to improve coagulation, the ferrous sulphate was replaced by alum used at the rate of 25 ppm. At the same time, use of a special type of magnesium silicate coagulent was started at the rate of 15 ppm. Coagulation improved somewhat, but it was evident that clarification had to be made more dependable and efficient. A coagulation specialist came to the plant to help work out improved procedures. Since the clarifiers operated in pairs, but could be charged separately with chemicals, it was possible to conduct tests on two tanks simultaneously under identical conditions except for the variable being studied. With that setup, "jar" tests were performed in batches of 120,000 gal—possibly the largest jar test ever made. Studies were made of the effects of different chemical combinations, varying chemical dosages, pH levels, length of agitation period, and other factors.

The effluent from the clarifiers was crystal clear by the end of the third day and remained clear throughout the remainder of the run. Best clarification was obtained with the following chemical dosages:

1. 12 ppm of sodium aluminate.
2. 25 ppm of a special type of magnesium silicate.
3. Lime sufficient to adjust effluent pH to 7.8 to 8.0.

Flow rates increased during this time due to loosening of the beds and improved coagulation, but it was found increasingly difficult to regenerate the beds properly and to obtain water sufficiently low in hardness. Maximum permissible hardness in the zeolite effluent had been arbitrarily set at 35 ppm. By that time, clear well hardness was 25 ppm and steadily increasing because the zeolite effluent hardnesses were reaching as high as 85 ppm before it was possible to regenerate the units. They were being regenerated as often and as rapidly as possible, but limitations of bed design prevented obtaining maximum capacity.

It was decided that proper operation of the beds would never be possible with the poor underdrain systems because:

1. Fouling of the underdrain piping caused non-uniform backwashing, brining, and rinsing of the beds. This is shown by the fact that samples of water from different areas of the same bed during rinsing contained from 70 to 700 ppm NaCl. Thus some parts of the freshly-regenerated beds were being exhausted before other parts were completely rinsed. When the beds were put on the line, most of the water would pass through shallow clean areas which were backwashed cleaner than dead areas. The effective capacity of each bed was thus greatly reduced.
2. Regeneration downflow in the approved manner could not be performed because of the gravel beneath the distribution system which would trap brine.

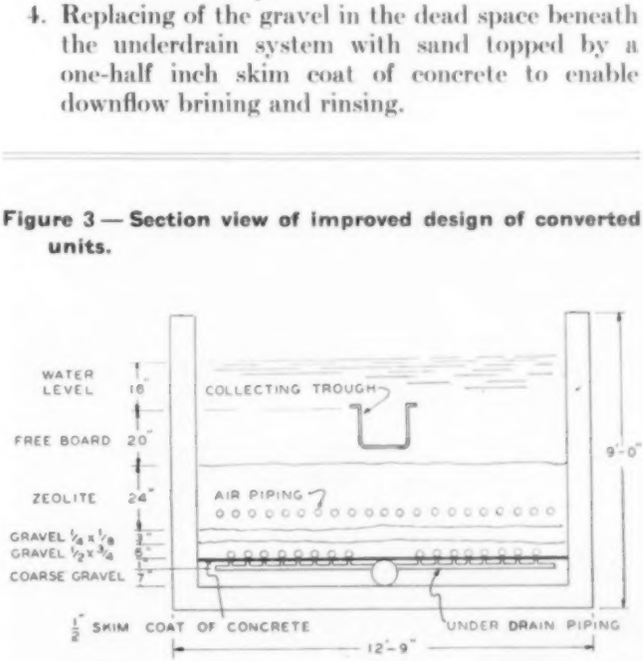
It would be well to mention that at that time, several days after the start of zeolite operation, solutions to the numerous operating problems were being sought and decisions being made in an atmosphere of extreme emergency because keeping the plant operating with this system was not a certainty at any time during the first ten days. Heavy rains added to the difficulties by doubling the river water hardness. This also made control of lime feed for pH adjustment of the plant service water difficult, resulting in a pH variation from 4.9 to 7.6 in the clarifier influent in one eight-hour period. Special efforts were required to maintain good coagulation under these conditions.

In spite of these difficulties, plans to convert other plants to this system continued at full speed because of confidence in the ultimate success of the plan, and because it was believed that the lessons being learned would enable smooth operation at other plants.

To study the zeolite operation in detail with the object of getting the most out of the beds in their existing condition, and to design a reliable and improved bed for future operation, a zeolite specialist visited the plant. Studies of various backwashing, brining, and rinsing procedures indicated that three of the five beds being used would have to be repaired or rebuilt before they would produce water of suitable quality. It was believed that the shortcomings of the original bed design would be overcome with the design shown in Figure 3. The improvements made were essentially as follows:

1. Renewal of the air distribution system.
2. Cleaning and repairing of the underdrain system.
3. Raising of the collecting trough to increase freeboard 10 in. and zeolite depth 4 in. This made the mineral depth 24 in., still appreciably below recommended depth.
4. Replacing of the gravel in the dead space beneath the underdrain system with sand topped by a one-half inch skim coat of concrete to enable downflow brining and rinsing.

Figure 3 — Section view of improved design of converted units.



This design was used in converting No. 6 bed which had not formerly been used with zeolite. This unit was intended to take the strain off the original units and to serve as a research unit to determine if this design should be followed in remodeling other beds. The new unit was put on the line ten days after the start of zeolite operation. It performed extremely well, delivering water of practically zero hardness and being regenerated when hardness reached 10 ppm. The excellent operation of this unit enabled a safe edge to be gained both in quantity and quality of treated water so that the three poorly-operating units could be remodeled, one at a time, along the same lines.

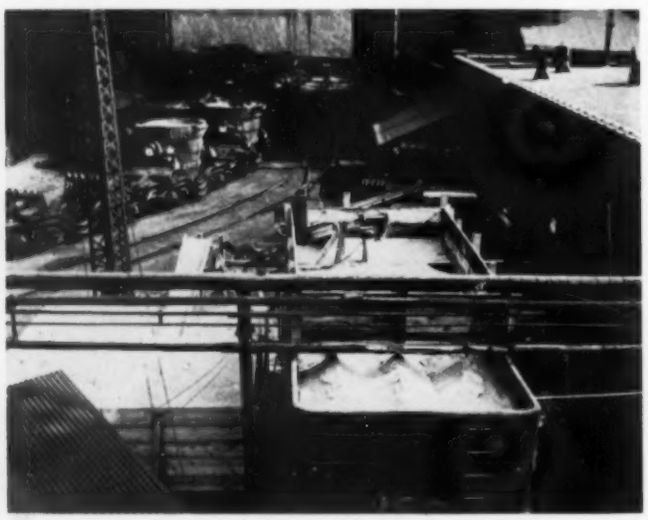
For the first time in ten days, the job was considered completely under control, with satisfactory operation assured for the remainder of the emergency. Engineers of our feedwater consultants had been on the job 24 hours a day up to this time. They continued to work closely with plant personnel who gradually assumed complete control of operation.

The major problems had been solved in the first ten days, but further improvements in the system were made. It was decided to install a brining system to minimize the manual labor required for dry-salting. It was also felt that this change would reduce salt costs and increase speed and efficiency of regeneration. A brine measuring tank 12 by 7½ by 5 ft was installed. In addition to measuring brine, this tank was initially used also for dissolving granulated salt carried to it by a portable conveyor. In operation, the proper quantity of brine, measured by a floating gage, was gravity fed by means of fire hose from the dissolving tank to the zeolite unit being regenerated.

The need for a suitable brine dissolving tank was filled quickly by the purchase of an old locomotive tender. A photograph of this makeshift equipment is shown in Figure 4. The tender served the purpose admirably because it was portable, immediately available, and of such dimensions that it could be used as a combination salt storage bin and dissolving tank.

This brining system, together with improved coagulation and remodeling of four of the beds, transformed the operation from one of haste and urgency to one of relaxed routine. Zeolite beds were regenerated when hardness reached 10 ppm, and produced essentially zero hardness water when put back on the line. Previously, each regeneration was rushed to permit taking another thoroughly exhausted unit off the line for regeneration. Now it was possible to keep regenerated units on standby for use when necessary. River water hardnesses had again returned to normal, but this reserve capacity assured satisfactory performance even if hardnesses of the raw water again increased. Actually, beds were now being regenerated for the purpose of cleaning rather than to restore softening capacity.

Figure 4 — An old locomotive tender was used as combination salt storage bin and dissolving tank.



Typical analyses of water samples from various parts of the system are shown in Table I.

The following conclusions can be drawn from a study of this emergency conversion to zeolite softening:

1. The project fulfilled its original purpose—preventing curtailment of production due to the soda ash shortage. With three converted plants in operation, soda ash consumption was reduced by 12,500 lb per day for a total of 880,000 lb during the emergency period. This saving was sufficient to keep all of the company plants in operation with the available receipts of soda ash.
2. Although initial operating difficulties proved to be greater than expected, total results were immensely better than anticipated as shown by the fact that operation was continued until November 12 although the soda ash strikes were settled by early October. In addition, this system was applied at two other softening plants without difficulty, largely due to lessons learned at the first plant. At the second of these plants, 5,500,000 gal of water were softened daily. It was planned to continue zeolite operation at the third plant, a smaller unit, well into 1951 because of the existing stock of salt and the simplicity and reliability of the system. However, this plant had to be reconverted sooner than planned because it was necessary to use the stock of salt to clear plant property of the record snowfall occurring in the latter part of November, 1950.
3. Inspections during and since the zeolite operation found internal conditions of boilers excellent. No undesirable effects on boiler operation were experienced.
4. Performance of the synthetic siliceous exchange mineral was completely satisfactory. Capacities remained above the specified 10,000 gr per cu ft throughout the period, despite severe operating conditions such as shallow bed depth and absence of filters ahead of the softeners.
5. Coagulation of Monongahela River water was excellent using sodium aluminate, a special type of magnesium silicate, and lime.
6. Although satisfactory water for boiler operation was obtained, reconversion back to lime-soda operation was dictated by consideration of labor and chemical expense as applied to this temporary operation.
7. Any future threat to production at these plants caused by a shortage of soda ash can be met promptly as a result of the experience gained during this operation. The zeolite mineral which was removed from the beds upon reconversion is being saved as security against any such threat.

AISE STANDARD NO. 10

CARBON BRUSH SIZE AND SHUNT STANDARDS

(TENTATIVE)

(SEPTEMBER 30, 1951)

FOREWORD

▲ THE Association of Iron and Steel Engineers set up a committee in 1946, with Mr. Hugh Conover as chairman, to work up standards to cover the size, length, breadth and type of shunting for motor brushes. This committee consisted at that time of the following members:

Hugh Conover, Repair and Maintenance Engineer, Carnegie-Illinois Steel Corp.

Walter H. Burr, Electrical Superintendent, Lukens Steel Co.

W. E. Clancy, Stackpole Carbon Co., St. Marys, Pa.

V. E. Schlossberg, Superintendent Electric and Power Departments, Inland Steel Co.

C. A. Hammer, Stackpole Carbon Co., St. Marys, Pa.

I. N. Tull, Electrical Superintendent, Republic Steel Corp.

The committee secured information from all large steel companies showing type and size of brushes used. This data was tabulated and a proposed standard was published in the February 1950 issue of the Iron and Steel Engineer.

In 1949, Mr. Conover retired from active participation in the iron and steel industry, and a new committee with E. L. Anderson as chairman was appointed to carry on the work of standardizing carbon brushes. This committee consists of the following members:

E. L. ANDERSON (Chairman), Electrical Superintendent, Bethlehem Steel Co., Johnstown, Pa.

C. B. HATHAWAY, Manager, D-C Motor Engineering Department, Westinghouse Electric Corp., Buffalo, N. Y.

A. H. GRAHAM, Manager, D-C Armored Motor Engineering Division, General Electric Co., Erie, Pa.

I. N. TULL, Electrical Superintendent, Republic Steel Corp., Cleveland, Ohio.

V. E. SCHLOSSBERG, Assistant Chief Engineer, Inland Steel Co., East Chicago, Ind.

J. F. DAVIS, D-C Armored Motor Engineering Division, General Electric Co., Erie, Pa.

E. J. ERDELSKY, Crocker Wheeler Division, Elliott Co., Ampere, N. J.

JAMES P. HANLON, Buyer, Purchasing Department, Bethlehem Steel Co., Bethlehem, Pa.

C. ROBERT EVANS, Purchasing Agent, Electrical Division, Republic Steel Corp., Cleveland, Ohio.

J. S. AHRENS, Manager Brush Department, National Carbon Co., Cleveland, Ohio.

V. J. NOLAN, Sales Promotion Manager, National Carbon Co., New York, N. Y.

C. A. HAMMER, Sales Engineer, Stackpole Carbon Co., St. Marys, Pa.

R. S. LEIDLER, Carbone Corp., Pittsburgh, Pa.

I. E. MADSEN, Standards Engineer, Association of Iron and Steel Engineers, Pittsburgh, Pa.

The makeup of the present committee is such that the motor industry, brush industry and steel industry had representation.

The original program of the committee was to standardize brushes for all motors except fractional horsepower motors. It was decided by the second committee that it might be better to make a trial on mill motors and the present standard covers only 230-v, d-c mill type motors. Further expansion of the project will depend on results obtained with the work already done.

As necessary in all such standardization work, a number of compromises had to be adopted. An example of this was the selection of shunt lengths which often were established between those used by different motor manufacturers. This reduced the number of brushes and eliminated any necessity for having two or more standard brushes which would be identical except for shunt length. Since the time the AISE committee established their lengths, the new NEMA standard CB1-1951, ASA C 64.1-1950 has been published, and this standard establishes shunt lengths of 1⅝, 2¼, 3, 4, 5½ and 7½ inches. These lengths differ somewhat from those used in AISE Standard No. 10 (tentative), and before the standard becomes final, the committee will again consider this question, which may require that additional brushes be added to the standard if NEMA lengths are to be used. Comments on this and other points from users of the AISE standard and members of the AISE are invited.

As a result of the give and take which took place on the part of all those concerned, the standard as now set up requires only 49 brushes. Previous experience on the part of plants who have engaged in plant wide standardization work indicate substantial economies should result from industry's acceptance of the standard. The standard is outlined in the following paragraphs.

AISE STANDARD NO. 10

CARBON BRUSH SIZE AND SHUNT STANDARDS

(TENTATIVE)

(SEPTEMBER 30, 1951)

I. PURPOSE

A. The chief purpose of this standard is to provide for economy and simplicity in purchasing and handling carbon brushes for the motors used in steel plants.

B. This standard establishes sizes for carbon brushes in order to reduce the total number of brushes which must be carried by the steel plant in the maintenance of mill motors.

C. The standard provides a line of brushes of standard sizes which will be interchangeable from a dimensional standpoint regardless of manufacturers.

II. SCOPE

A. The standard covers only straight radial brushes used on 230-v, d-c mill type, crane and railway type crane motors.

B. Brush grades are not standardized in this specification.

C. No attempt has been made to standardize on size of shunts.

D. Shunt locations are limited to positions 1, 2, 3, 7, 8 and 9.

E. The standard does not cover saddles or clips.

F. The standard does not cover the method of attaching the shunt to the brush.

III. GENERAL

A. By standardizing only the size of brush, length of shunt and type terminal, the manufacturer is left ample leeway for design and grade improvements.

B. A code number has been set up for convenience, which designates the size of the brush and this may be used for identification purposes. In this Code No., the thickness, width, and length will be expressed in sixteenths of an inch and listed in the order of thickness, width and length. Thus, Code No. 042024 indicates a brush ¼ in. thick × 1¼ in. wide × 1½ in. long. A prefix of S before the Code No. or brush size indicates a split brush. In a split brush the dimension is the total thickness of the brush. A prefix of D indicates two duplicate brushes with shunts connected to a common terminal. In such a double brush, the dimensions given are for each individual brush.

C. The prefix S in the terminal column indicates a terminal with a straight slot. The number 7 or 9 indicates the width of the slot in thirty-seconds of an inch.

IV. STANDARD

A. The size of the brush (thickness, width and length), the length of the shunt and the type terminal will be as specified in Table I which is a listing of the standard brushes. Tables II, III, IV and V are listings of motors which specify the brush for each particular motor.

B. All shunts are to be coated with tin, lead or other metallic protective coating.

C. All terminals will be as specified in Table I.

TABLE I

AISE STANDARD BRUSHES

Brush Standard No.	Brush Code No. t-w-l	Brush Size in. t-w-l	230-v Motors	Shunt Length in.	Terminal†
1	042024	¼ x 1¼ x 1½	K1	3½	S 7
2	061232	⅜ x ¾ x 2	CW 602 MD 402	4½	S 9
3	061436	⅜ x ⅞ x 2¼	2W 5 3W 7½ SW 5 SW 7½	5½	S 9
4	061628	⅜ x 1 x 1¾	W 602 MD 102	3½	S 9
5	062028	⅜ x 1¼ x 1¾	W 603 MC 2 MC 21 K 2	3½	S 9
6	062832	⅜ x 1¾ x 2	MC 31 MC 41 MC 3 MC 4	4½	S 7
7	063232	⅜ x 2 x 2	K 6	5½	S 7
8	071228	7/16 x ¾ x 1¾	MD 101	3½	S 7
9	081232	½ x ¾ x 2	GE 602 GE 603 CW 603 MD 403	4½	S 9
10	081436	½ x ⅞ x 2¼	SW 10 4W 10	5½	S 9
11	081632	½ x 1 x 2	CW 604 GE 604 W 604 MD 404 MD 406	5	S 9
12	081832	½ x 1⅛ x 2	AW BW	5½	S 9
13	081836	½ x 1⅛ x 2¼	SW 15 6W 15	5½	S 9
14	082028	½ x 1¼ x 1¾	MD 103	3½	S 7
15	082432	½ x 1½ x 2	K 3	5½	S 7
16	082436	½ x 1½ x 2¼	MC 20 MC 61 MC 6 MC 40 MT 000 K 9	5½	S 9
17	D082440*	D ½ x 1½ x 2½	W 616 W 618	5½	S 9
18	082836	½ x 1¾ x 2¼	MC 30	5½	S 9
19	S102036**	S ⅝ x 1¼ x 2¼	CW 606 GE 606	5	S 9
20	102040	⅝ x 1¼ x 2½	MD 105 W 606	5½	S 9
21	102436	⅝ x 1½ x 2¼	MD 104 MD 408 MD 412 MC 8 MC 81 K 4	4½	S 9
22	S102436**	S ⅝ x 1½ x 2¼	CW 610 GE 610 CW 614 GE 614 MD 416	5	S 9

TABLE I—Continued

Brush Standard No.	Brush Code No. t-w-l	Brush Size in. t-w-l	230-v Motors	Shunt Length in.	Terminal†
23	102636	5/8 x 1 5/8 x 2 1/4	CW DW SW 25 SW 35 SW 50 8W 25 10W 35 12W 50	5 1/2	S 9
24	S102836**	S 5/8 x 1 3/4 x 2 1/4	CW 608 GE 608 MD 410	5	S 9
25	102836	5/8 x 1 3/4 x 2 1/4	K 5 MC 50 W 608	5	S 9
26	103236	5/8 x 2 x 2 1/4	SW 100 16W 100	5 1/2	S 9
27	121828	3/4 x 1 1/8 x 1 3/4	MD 104 1/2	2 1/2	S 7
28	S122436**	S 3/4 x 1 1/2 x 2 1/4	CW 612 W 612 W 614 MD 418	5 1/2	S 9
29	122440	3/4 x 1 1/2 x 2 1/2	MC 10 MC 60 MC 101 MC 121 MC 12 MT 00 MT 0	5 1/2	S 9
30	S122836**	S 3/4 x 1 3/4 x 2 1/4	GE 612 CW 616 GE 616 MD 414	5	S 9
31	122844	3/4 x 1 3/4 x 2 3/4	56A	8	S 7
32	123240	3/4 x 2 x 2 1/2	EW FW SW 75 SW 150 14W 75 18W 150 MC 70 MC 80 MC 90 MC 100 MC 141 MC 161 MC 181 MC 14 MC 16 MC 18 K 6	5 1/2	S 9
33	S123240**	S 3/4 x 2 x 2 1/2	W 610 MD 421 MD 422 MD 422N MD 423 GE 618	4 1/2	S 9
34	123640	3/4 x 2 1/4 x 2 1/2	162 G 2W	5 1/2	S 9
35	124036	3/4 x 2 1/2 x 2 1/4	HW IW	5 1/2	S 9
36	124848	3/4 x 3 x 3	38B 47 47A 47J	5 1/2	S 9
37	142036	7/8 x 1 1/4 x 2 1/4	MD 106	5	S 9
38	S142836**	S 7/8 x 1 3/4 x 2 1/4	CW 618	5	S 9

TABLE I — Concluded

Brush Standard No.	Brush Code No. t-w-l	Brush Size in. t-w-l	230-v Motors	Shunt Length in.	Terminal†
39	143240	7/8 x 2 x 2 1/2	MD 420 MD 420 1/2	4 1/2	S 9
40	144036	7/8 x 2 1/2 x 2 1/4	GW	5 1/2	S 9
41	162036	1 x 1 1/4 x 2 1/4	MD 107 MD 108 MD 109 MD 109 1/2	5	S 9
42	162440	1 x 1 1/2 x 2 1/2	MT 1 MT 2 K 9	5 1/2	S 9
43	162844	1 x 1 3/4 x 2 3/4	MT 3 MT 5 K 10	5 1/2	S 9
44	163240	1 x 2 x 2 1/2	MC 103 MT 4 MT 6	5 1/2	S 9
45	163236	1 x 2 x 2 1/4	K 7	5 1/2	S 9
46	163636	1 x 2 1/4 x 2 1/4	K 8	5 1/2	S 9
47	163844	1 x 2 3/8 x 2 3/4	12A 48 48A 48E	7	S 9
48	182036	1 1/8 x 1 1/4 x 2 1/4	MD 110	5	S 9
49	201640	1 1/4 x 1 x 2 1/2	165	5 1/2	S 9

*A prefix of D indicates two duplicate brushes with shunts connected to a common terminal.
In such a double brush the dimensions given are for each individual brush.

**A prefix of S indicates a split brush. In a split brush the dimension is the total thickness of the brush.

†A Type S terminal is a straight type with slot. The numbers 7 and 9 refer to slot opening in thirty-seconds of an inch. Thus a S 7 terminal is a straight slot which has a 7/32 in. opening.

TABLE II

Brushes for 600 Series Mill Motors

AISE Frame	General Electric Motors		Westinghouse Motors		Crocker-Wheeler Motors	
	AISE Brush Standard No.	AISE Brush Code No.	AISE Brush Standard No.	AISE Brush Code No.	AISE Brush Standard No.	AISE Brush Code No.
2	2	061232	5	062028	3	061436
602	9	081232	4	061628	2	061232
603	9	081232	5	062028	9	081232
604	11	081632	11	081632	11	081632
606	19	S102036	20	102040	19	S102036
608	24	S102836	25	102836	24	S102836
610	22	S102436	33	S123240	22	S102436
612	30	S122836	28	S122436	28	S122436
614	22	S102436	28	S122436	22	S102436
616	30	S122836	17	D082440	30	S122836
618	33	S123240	17	D082440	38	S142836

TABLE III

Brushes for General Electric Motors

General Electric Motor No.	AISE Brush Standard No.	AISE Brush Code No.
MD 402	2	061232
MD 403	9	081232
MD 404	11	081632
MD 406	11	081632
MD 408	21	102436
MD 410	24	S102836
MD 412	21	102436
MD 414	30	S122836
MD 416	22	S102436
MD 418	28	S122436
MD 420	39	143240
MD 420½	39	143240
MD 421	33	S123240
MD 422	33	S123240
MD 422N	33	S123240
MD 423	33	S123240
MD 101	8	071228
MD 102	4	061628
MD 103	14	082028
MD 104	21	102436
MD 104½	27	121828
MD 105	20	102040
MD 106	37	142036
MD 107	41	162036
MD 108	41	162036
MD 109	41	162036
MD 109½	41	162036
MD 110	48	182036

TABLE IV

Brushes for Westinghouse Motors

Westinghouse Motor No.	AISE Brush Standard No.	AISE Brush Code No.
38B	36	124848
47	36	124848
47A	36	124848
47J	36	124848
12A	47	163844
48	47	163844
48A	47	163844
48E	47	163844
56A	31	122844
162	34	123640
165	49	201640
MC 20	16	082436
MC 30	18	082836
MC 40	16	082436
MC 50	25	102836
MC 60	29	122440
MC 70	32	123240
MC 80	32	123240
MC 90	32	123240
MC 100	32	123240
MC 103	44	163240
MC 21	5	062028
MC 31	6	062832
MC 41	6	062832
MC 61	16	082436
MC 81	21	102436
MC 101	29	122440
MC 121	29	122440
MC 141	32	123240
MC 161	32	123240
MC 181	32	123240

TABLE IV—Continued

Brushes for Westinghouse Motors

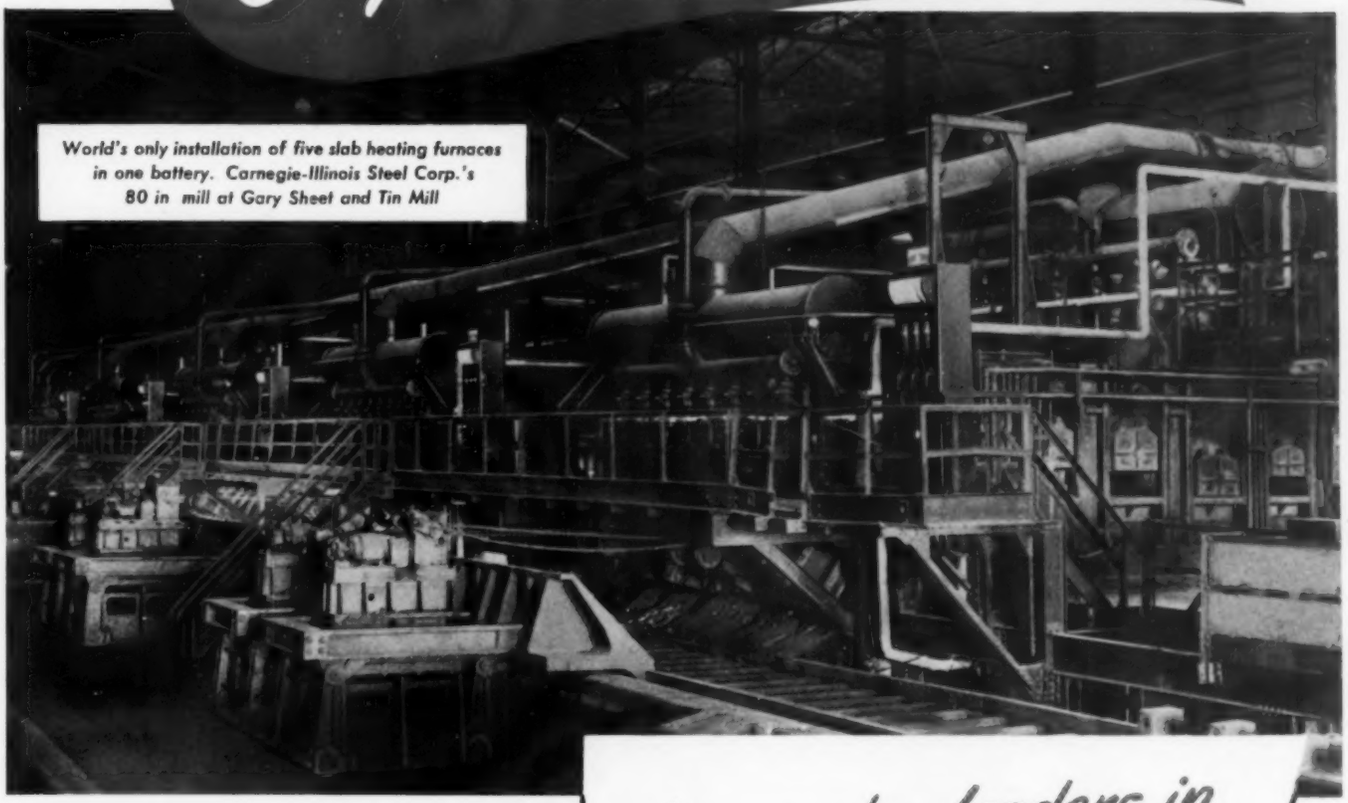
Westinghouse Motor No.	AISE Brush Standard No.	AISE Brush Code No.
MC 2	5	062028
MC 3	6	062832
MC 4	6	062832
MC 6	16	082436
MC 8	21	102436
MC 10	29	122440
MC 12	29	122440
MC 14	32	123240
MC 16	32	123240
MC 18	32	123240
MT 000	16	082436
MT 00	29	122440
MT 0	29	122440
MT 1	42	162440
MT 2	42	162440
MT 3	43	162844
MT 4	44	163240
MT 5	43	162844
MT 6	44	163240
K 1	1	042024
K 2	5	062028
K 3	15	082432
K 4	21	102436
K 5	25	102836
K 6	32	123240
K 6	7	063232
K 7	45	163236
K 8	46	163636
K 9	42	162440
K 9	16	082436
K 10	43	162844

TABLE V

Brushes for Crocker Wheeler Motors

Crocker Wheeler Motor No.	AISE Brush Standard No.	AISE Brush Code No.
AW	12	081832
BW	12	081832
CW	23	102636
DW	23	102636
EW	32	123240
FW	32	123240
GW	40	144036
HW	35	124036
IW	35	124036
G 2W	34	123640
SW 5	3	061436
SW 7½	3	061436
SW 10	10	081436
SW 15	13	081836
SW 25	23	102636
SW 35	23	102636
SW 50	23	102636
SW 75	32	123240
SW 100	26	103236
SW 150	32	123240
2W 5	3	061436
3W 7½	3	061436
4W 10	10	081436
6W 15	13	081836
8W 25	23	102636
10W 35	23	102636
12W 50	23	102636
14W 75	32	123240
16W 100	26	103236
18W 150	32	123240

Only RUST has it *



World's only installation of five slab heating furnaces in one battery. Carnegie-Illinois Steel Corp.'s 80 in mill at Gary Sheet and Tin Mill

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Rust gives you positive control of heating quality and tonnage output. Flexibility is achieved by simply changing rate of fuel fired. Unique design maintains constant soaking chamber heat for any specific rolling temperature . . . uniform heating efficiency with a minimum of fuel.

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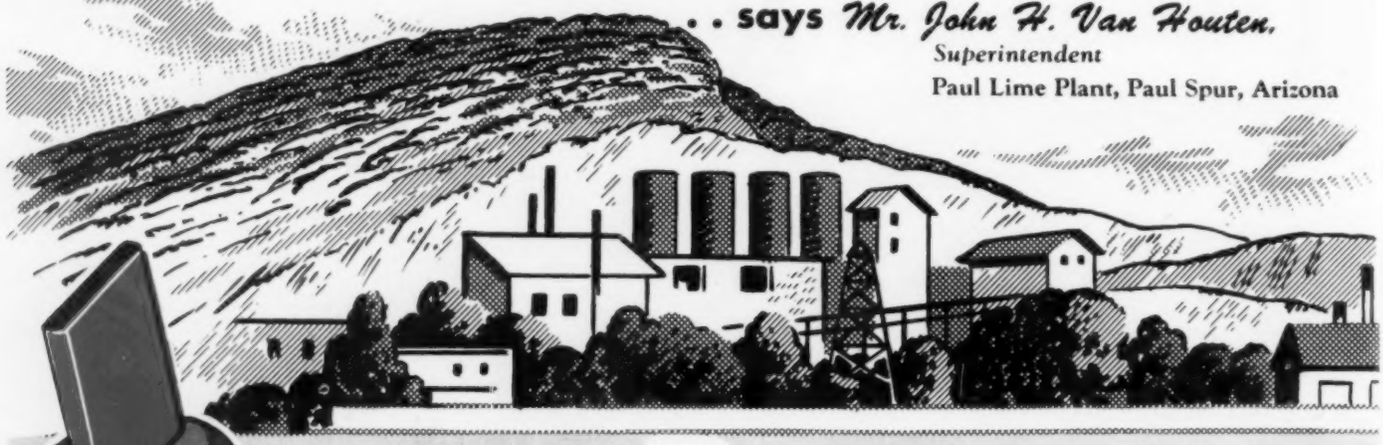
F-1

"The cost of changing to FUSETRON dual-element FUSES has been paid for more than ten times over in sustained production time"

. . . says *Mr. John H. Van Houten,*
Superintendent
Paul Lime Plant, Paul Spur, Arizona



HERE'S HOW

"Prior to February, 1948 we used ordinary renewable fuses throughout our plant. They gave us short-circuit protection but we lost a great many motors due to single phasing, excessive heating and climatic conditions.

"When a motor goes out in a plant like ours, it costs us a loss in production that is difficult to make up.

"In February, 1948 we changed the whole plant over to Fusetron fuses. On the motors we installed a size to give motor running protection.

"We have completely eliminated motor losses due to single phasing and believe we have better all-around protection than before.

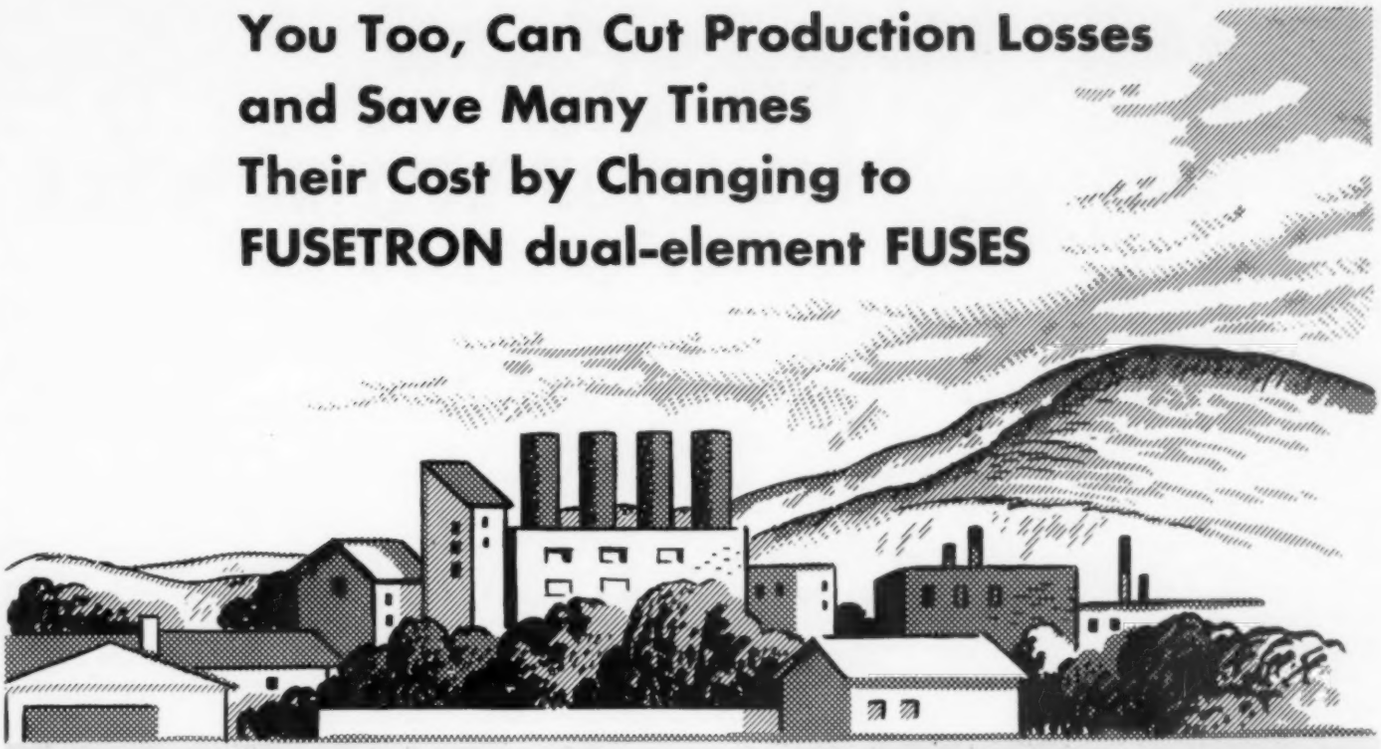
"Our records show that the cost of changing to Fusetron fuses has been paid for more than ten times over in sustained production time.

"What more could we ask?"

John H. Van Houten

(Fusetron is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.)

You Too, Can Cut Production Losses and Save Many Times Their Cost by Changing to FUSETRON dual-element FUSES



HERE'S WHY

FUSETRON dual-element FUSES GIVE 10 POINT PROTECTION

1. ★Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

★Fusetron fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December 1947.

DON'T RISK LOSSES!

One **lost** motor . . .
One **needless** shutdown . . .
One **destroyed** switch or panel
One **burned out** solenoid . . .

May cost you far more than replacing every ordinary fuse with a Fusetron dual-element Fuse.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

USE THE COUPON

Bussmann Mfg. Co.,
University at Jefferson,
St. Louis 7, Mo.
(Division of McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

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Company.....

Address.....

City & Zone..... State.....

1151

Magnetic Amplifier Control

FOR ROLLING MILLS

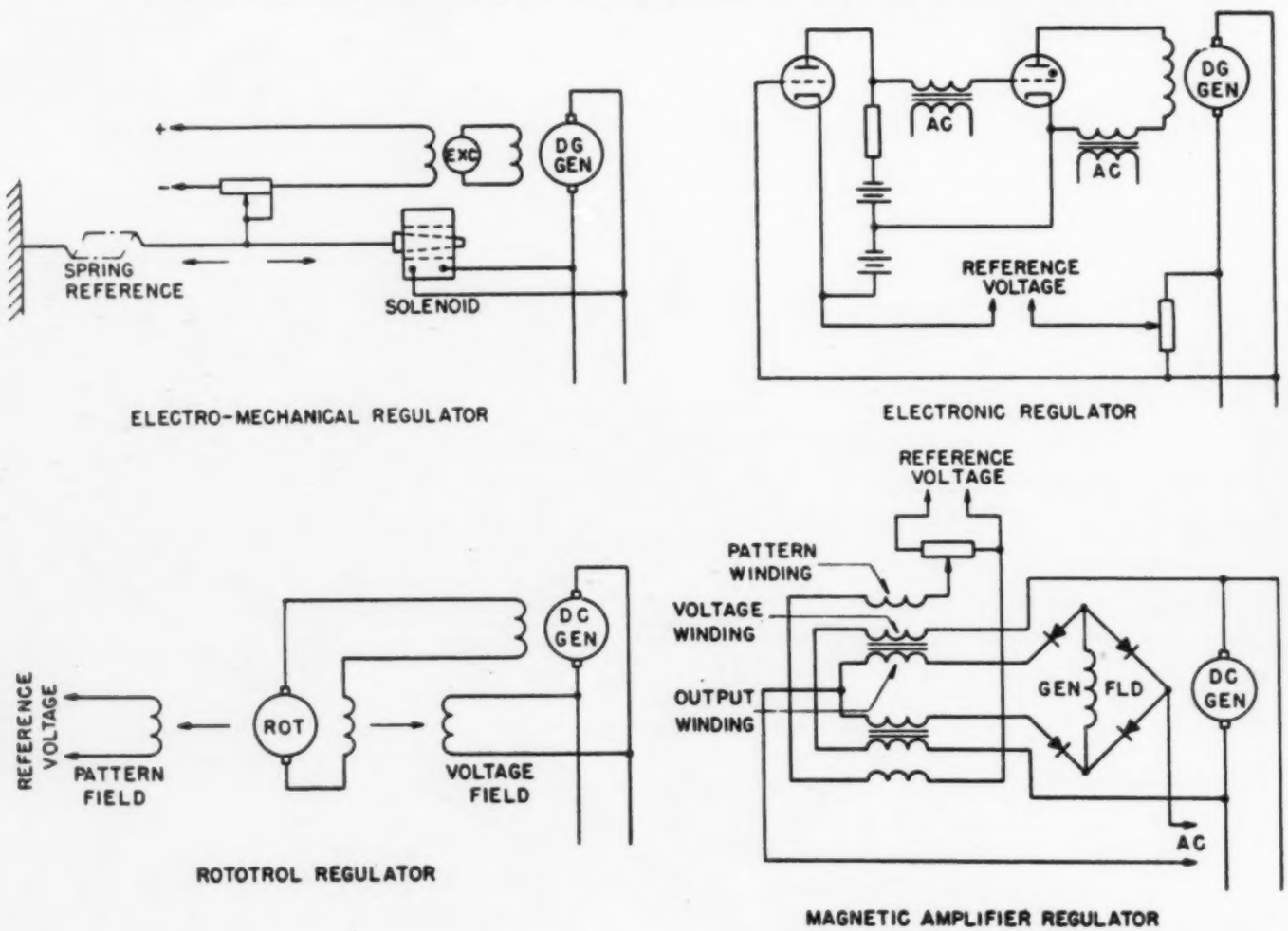
. . . . a pilot plant demonstration showing the possibilities of magnetic amplifier control was held before a number of steel plant operators on October 19, 1951 . . . .

▲ The magnetic amplifier—Magamp, as it is called—has been known and used for years. The first applications were simple saturable-core reactors in which the impedance of the reactor was changed by saturating the core with a direct current control winding. More recently, the device is being applied in all types of control and regulating circuits in practically every electrified industry in the country.

The renewed interest in the use of the magnetic amplifiers can be attributed to three major factors:

1. The self-saturating circuit, which makes possible high values of gain is now fully understood and is used in all modern devices.
2. The performance of self-saturating Magamps depends greatly on the core material and the rectifiers used. Recent improvements in these components have made it possible to capitalize on the self-saturating circuit.
3. The steel industry is using more automatic regulating equipment on drive systems than ever before. This is caused by increases in speed, continuous striving for better quality, the demand for higher tonnages from existing facilities, and the need to eliminate the

Figure 1 — Steel mill regulating equipment can be broken down into four fundamental types.



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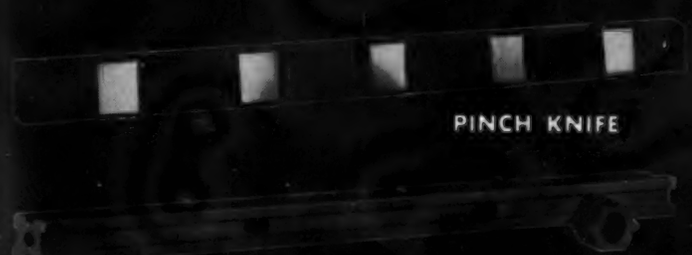
SHEET BAR KNIFE

HALF SLITTER



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STRUCTURAL KNIFE

human effect in duplication of results. Thus the demand has arisen for a static, simple, and maintenance free regulating device. The Magamp fits these requirements exactly. It is an entirely static device, is relatively simple, and will operate with less maintenance than other conventional types of regulating systems.

To bring out the fundamentals of the magnetic amplifier regulator, Figure 1, which shows schematically the four main types of regulating equipment has been prepared. All regulators are arranged to control the voltage of a direct current generator. In studying this chart it is desirable to bear in mind the requirements which all regulators must meet:

1. They must accurately measure the quantity to be regulated.
2. They must compare this measurement to a fixed reference standard.
3. They must exert corrective action to reduce deviations of the regulated quantity from the reference standard.
4. They must provide the degree of response and accuracy required and be stable.

The electro-mechanical regulator shown on Figure 1 uses a spring as a fixed reference. The regulated quantity is measured by a solenoid which acts in opposition to the pull of the spring. Any variation in the direct current generator voltage will unbalance these pulls and move the rheostatic element which changes the exciter voltage in the direction to return the generator voltage to the proper value.

The electronic-regulator uses a reference voltage as a fixed standard against which the voltage of the d-c generator is bucked. Any difference in these voltages applies a bias to the grid of the vacuum tube. The vacuum tube then acts to change the firing point of the grid controlled thyratron tube which supplies power to the direct current generator field. Thus any variation in direct current generator voltage will cause a corrective change in its shunt field strength through action of the electronic regulator.

The rototrol rotating regulator uses a reference voltage applied to the pattern field as a fixed standard. The voltage field measures the direct current generator voltage and is connected in opposition to the pattern field. Any difference in generator voltage will disturb the balance between the fields and change the rototrol voltage in such a direction as to return the direct current generator voltage to its proper value. Such regulators are frequently applied with the reference voltage, and generator voltage bucked against one another and the difference applied to a single rototrol field.

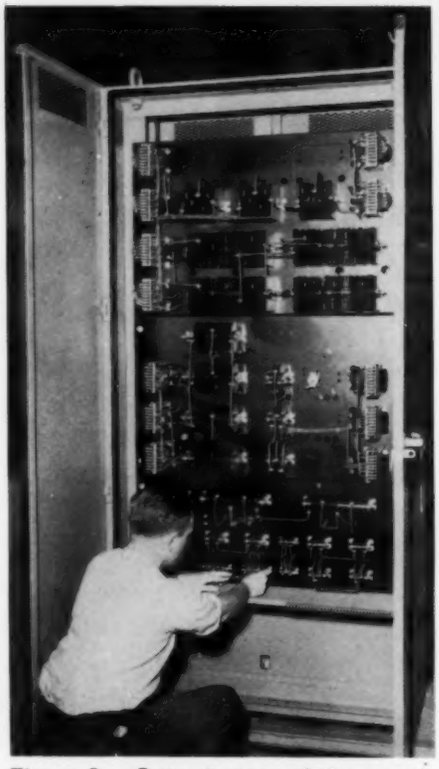
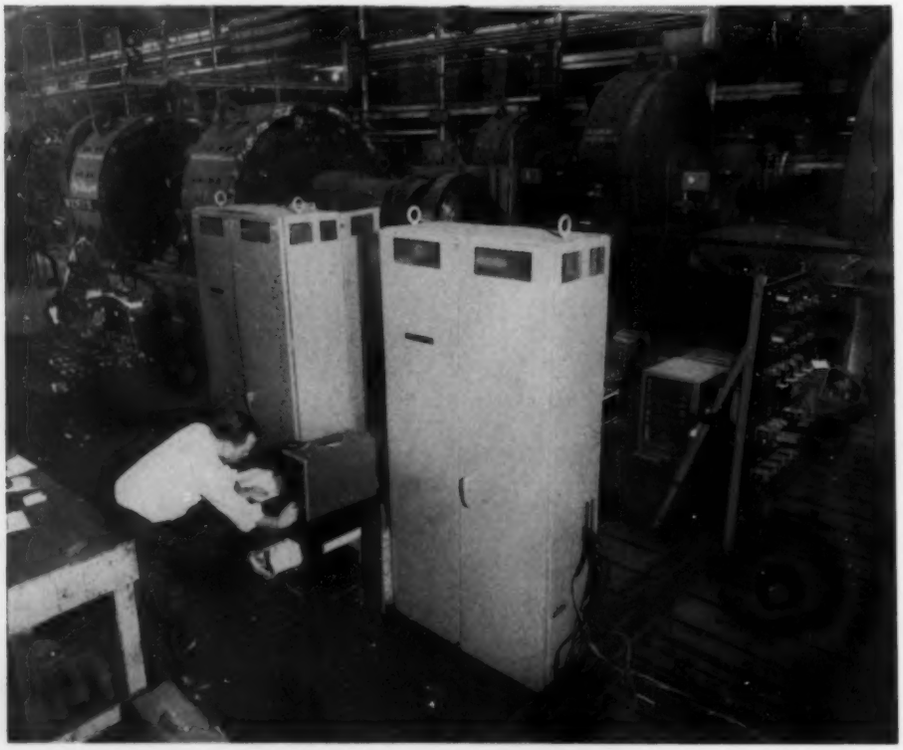


Figure 3 — Output stage of the experimental magnetic amplifier regulator, which supplies power directly to the field of the 3600-kw d-c generator.

Figure 2 — Magnetic amplifier regulator, under simulated operating conditions, for a tandem cold reduction mill. The 4000-hp, 200/485-rpm, double-armature motor is controlled by adjusting the voltage of the 3600-kw, 360 rpm generator, which is part of the large motor-generator set shown in the background.



The magnetic amplifier has pattern and voltage windings which are analogous to rototrol fields. Small differences in the strength of these windings will saturate the magnetic cores and cause large changes in the output windings. The alternating current of the output winding is rectified and applied as a d-c voltage to the generator shunt field. Thus small changes in strength of the pattern and voltage windings will apply large corrective voltages to the generator field and thereby keep the generator voltage within narrow limits.

Since the use of Magamp control fields is analogous to use of rototrol control fields, the application experience built up on rotating regulators is extremely useful in designing magnetic amplifier circuits.

The primary advantages of the Magamp compared with other types of regulating equipment are as follows:

1. Requires no periodic maintenance —there are no tubes to replace and

(*Please turn to page 118*)

Bliss Modernizes Temper Mill at U. S. Steel's Irvin Works

After 16 years of rugged service—much of it 'round the clock—a Bliss 4-high temper pass mill, at United States Steel Company's Irvin Works, was recently rebuilt by Bliss engineers. Its speed was increased to 2500 fpm.

U. S. Steel sees a future range of 250 to 3750 fpm for this *completely modern mill*, now handling coils of steel up to 50 inches wide, 72 inches in diameter, and weighing 50,000 pounds. All operations are directed from cabinets at each end—tension being controlled to any desired degree through the full cycle of any pass.

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If you plan improvements in either hot-rolling or cold-rolling facilities—ferrous or non-ferrous—put your problem up to Bliss engineers. They will see your job through to completion.

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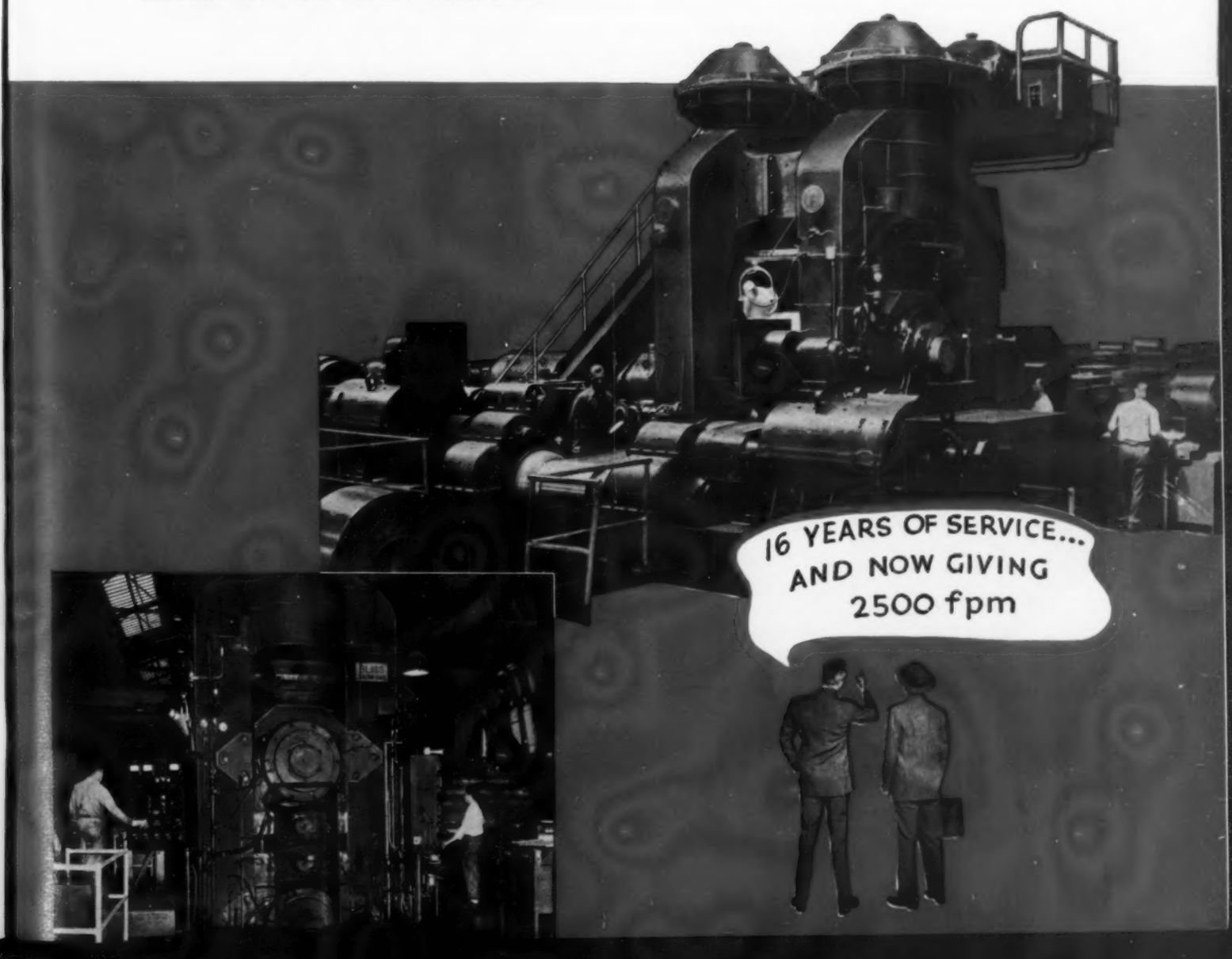
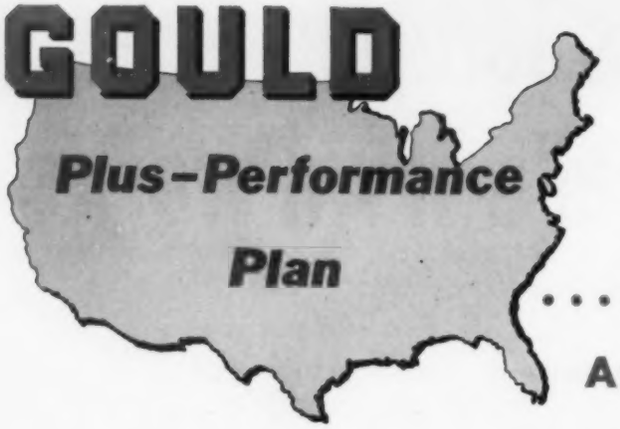


GOULD



...SHOWS YOU HOW ACCURATE RECORDS

LENGTHEN BATTERY SERVICE!

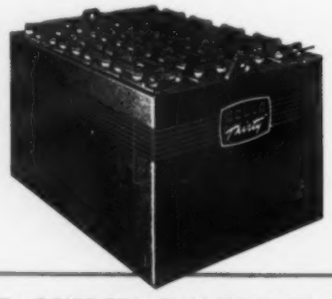
Keeping of accurate records is vital to the conservation and extension of essential battery power. The GOULD PLUS-PERFORMANCE PLAN makes the keeping of battery records easy by providing you with full information on how to test your batteries, and charts and forms for recording test data.

This timely plan puts at your disposal a complete system of manuals, articles, specifications, bulletins, charts, graphs and forms explaining and illustrating how to select, charge and handle, maintain and determine the condition of your batteries. This material, which can increase battery service as much as 50%, is FREE to battery users, without obligation. A request on your letterhead will bring descriptive booklet by return mail.

DAILY RECORD SYSTEM CONTROLS BATTERY MAINTENANCE

Number each battery and, as each is installed, read and record its specific gravity and temperature on chart illustrated below (these charts are FREE on request to users of the GOULD PLUS-PERFORMANCE PLAN). Record also, date each battery is put into service, and vehicle to which each is assigned. When each battery is charged, specific gravity, temperature, time, setting of ampere-hour meter and the date and amount of water are recorded.

Such a record tells 1) whether batteries are fully charged when placed in service; 2) number of hours each battery was in service; 3) if batteries were discharged below normal value; 4) whether batteries are being properly charged; 5) when batteries should be changed to prevent overworking and resultant failure during shift.



The GOULD "Thirty" with "Z" PLATES—
America's Finest Industrial Truck Battery

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User_____ Date_____ 19____

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PILOT CELL AND VEHICLE METER READINGS

The "Start of Charge" readings to be taken just after charge is started. The "End of Charge" readings to be taken just before charge is stopped.

PILOT CELL IS CELL NO. _____

After every 10 or so gravity readings of the pilot cell, a different cell should be used as a pilot in order to avoid lowering of its gravity due to possible loss of a small amount of electrolyte each time the gravity is read.

INDIVIDUAL CELL READINGS (To be recorded once every three months for each battery)

Battery No. _____

Date_____

Specific Gravity readings taken

_____ A.
_____ P.M.

Voltage readings taken

_____ A.
_____ P.M.

Charging while taking readings _____ Current voltage _____ Amps.

[Specific] Gravity

REGULAR CHARGE READINGS -- INCLUDING BOOSTS BUT NOT INCLUDING EQUALIZING CHARGES

Date	Vehicle No.	Battery No.	Start of Charge						End of Charge				
			Time Started	Timer Setting Hours	Amp. Hour Meter Reading	Charge Rate Amperes	Pilot Cell Sp. Gr.	Pilot Cell Temp.	Amp. Hour Meter Reading	Charge Rate Amperes	Pilot Cell Sp. Gr.	Pilot Cell Temp.	Time Stopped

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METAL GIRDLES for ENERGIES, LIQUIDS, GASES

In the mills that roll plate Mack-Hemp Rolls *with the striped red wabblers* set the productioneering pace because they were progressively developed for that task as rolling techniques progressed. And in skelp mills, too, the engineers and metallurgists of Mack-Hemp have always coordinated their roll research with operators' demands.

That's why so much of the skelp and plate tonnage used in vital pipe production —an estimated 9,000,000 tons in 1950— comes from mills using Striped Red Wabbler Rolls, for roughing and finishing, for work or back-up. It's understandable that so many rollers prefer Mack-Hemp Rolls for plate and skelp rolling because the records of tonnage service are always outstanding.

And, as always, Mack-Hemp is keeping ahead of the developments in rolling practice. It's that alertness to progressive changes that makes it worthwhile to keep an eye on what's new at Mack-Hemp.

MACKINTOSH-HEMPHILL

COMPANY

Makers of the Rolls with the Striped Red Wabblers

PITTSBURGH AND MIDLAND, PA.

MACKINTOSH-HEMPHILL PRODUCTS INCLUDE: rolls . . . steel and special alloy castings . . . completely integrated strip mills . . . heavy duty engine lathes . . . Mackintosh-Hemphill rotary straighteners . . . improved Johnston patented corrugated cinder pots and slag-handling equipment . . . shape straighteners . . . end-thrust bearings . . . shears . . . levellers

(*Continued from page 114*)

no bearings, brushes, or commutators.

2. Units can be panel mounted and wired, and installation expense will be reduced.

The Westinghouse Co., as part of its overall regulating system development activity, decided to investigate the possibilities of the Magamp as a control system for individual generator tandem cold reduction mills. The development was made with a view toward equaling and exceeding if possible, the excellent performance obtained from rototrol rotating regulator systems now in use. Such a control system must have the following features:

1. High amplification and thus high accuracy to provide the proper tracking of all stands from threading to maximum speeds.
2. Very fast and well damped transient response to assure the best mill performance during acceleration, deceleration, and emergency stops.
3. No overshoot under operating conditions.
4. Simplicity of scheme and adjustments for IR drop compensation, amplification, and damping.
5. Low maintenance and stay-put features which would assure that once the device is adjusted it will remain in adjustment.

The procedure for developing this regulator system was as follows:

1. Engineers from the steel mill application group, control engineering dept., and anacom laboratory and research dept., met to discuss the criteria for such a system. It was decided to replace the conventional rotating regulators and exciters completely with Magamps and to aim for a system which would have the ultimate in speed of response. After these basic concepts were sufficiently worked out complete tests were run in the anacom transient analyzing laboratory to determine what system had the best possibilities. The ultimate in response is obtained when the regulating and control elements have no time delay or the time delay is minute compared to the time delays in the fields of the main rotating equipment. The anacom studies showed that such a system could be designed and that it would be inherently stable since a single time delay system would be approximated.
2. On the basis of the anacom studies, a complete system was designed by steel mill and control engineers. These engineers received help from the Westinghouse magnetic amplifier division which is presently engaged in designing and manufacturing magnetic amplifiers for military and commercial applications.
3. In order to prove the system developed it was tested on full scale steel mill equipment on the test floor in the transportation and generator division. The equipment used is the No. 4 stand motor and its power supply generator which will be shipped to the Republic Steel Corp. for installation on a 66-in. four-stand tandem mill. The generator is rated 3600 kw at 360 rpm, and the motor is a 4000-hp, 200/485-rpm double armature unit. One 2000-hp armature drives the other armature as an inertia load which simulates the WR^2 of an actual mill installation. The reference bus system and the control devices are the same as those actually used in tandem mill service. Figures 2, 3 and 4 show the test equipment and the experimental Magamp regulators.

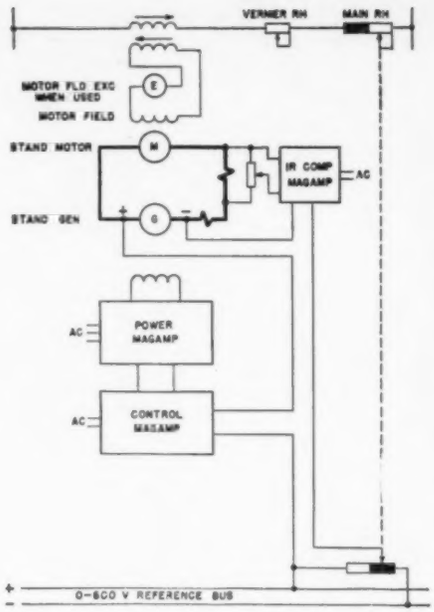

Figure 5 — Schematic diagram of individual generator tandem cold mill drive using Magamp.

Figure 4 — Control stage and IR drop compensation magnetic amplifiers, mounted on the back side of the cabinet.

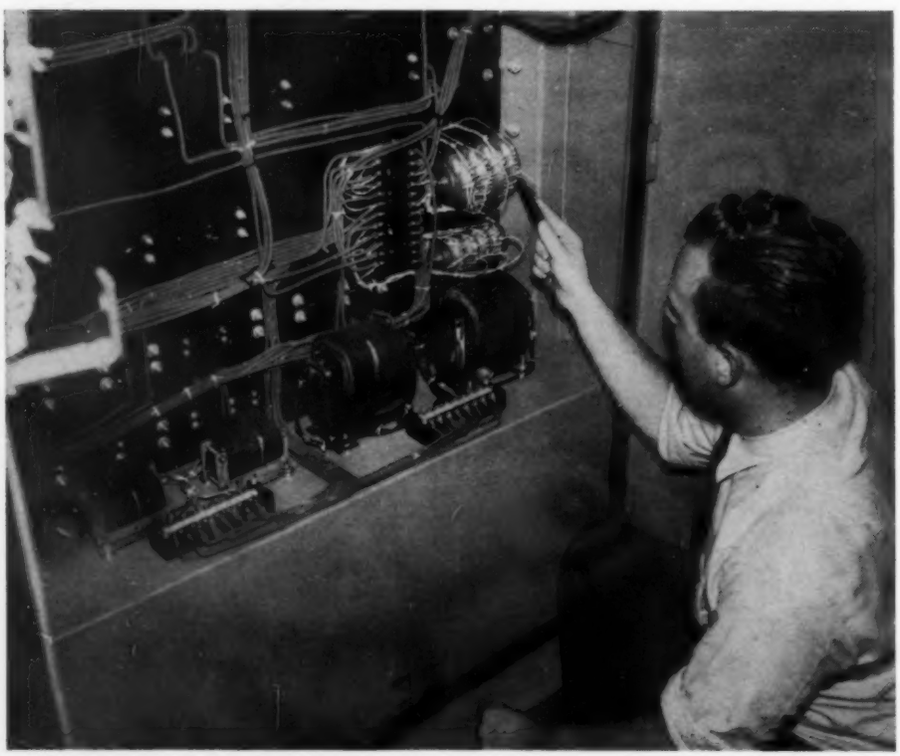

Figure 5 shows schematically the Magamp control system for one stand of an individual generator drive system. It may be directly compared to the rotating regulator system shown on Figure 4 of the article "Acceleration Characteristics of Tandem Cold Reduction Mills," by W. R. Harris and R. W. Moore, July 1951 Iron and Steel Engineer. All stands are matched to the same reference bus and the mill is accelerated and decelerated by

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A WORLD'S RECORD FOR "TOOL STEEL PROCESS" SCREW DOWN SCREWS ESTABLISHED ON 46" BLOOMING MILL AT INLAND STEEL CO.

"TOOL STEEL" PRODUCTS ARE GUARANTEED TO GIVE LONGER LIFE THAN ANY OTHER PRODUCTS IN THE SAME SERVICE!

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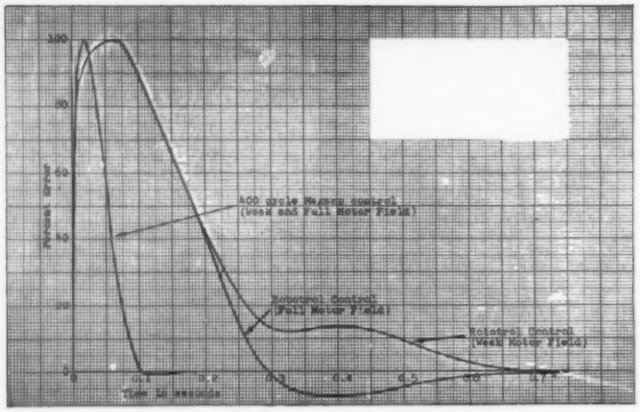

Figure 6 — Transient response at 50 per cent rated voltage for a change of 2 per cent on instantaneous reference bus.

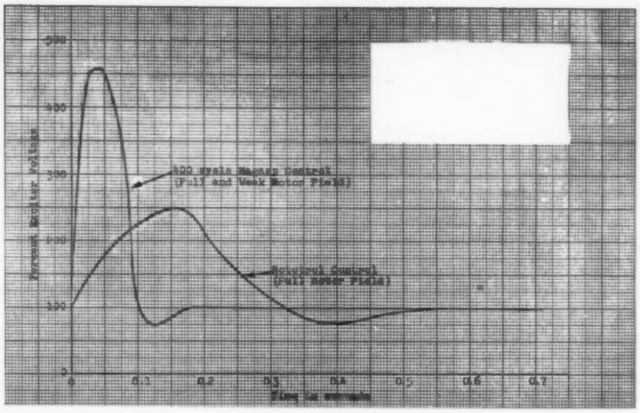

Figure 7 — Exciter response at 50 per cent of rated voltage for change of 2 per cent on instantaneous reference bus.

raising or lowering the reference bus. The generator voltage is bucked against the reference bus and the difference applied to the control Magamp. If the generator voltage is different from the reference bus, the control Magamp changes its output. In turn the output of the power Magamp, and the generator voltage is changed to correct the difference. IR drop compensation is applied by a small separate Magamp so that adjustment of IR drop compensation will be simple and will be independent of other system adjustments.

The response of the magnetic amplifier is inversely proportional to the frequency of the a-c power supply, and to determine the results, tests on both a 60-cycle and a 400-cycle device were planned. Analog computer studies showed that while the 60-cycle system would be faster than the rototrol, a 400-cycle system would be required to obtain the ultimate in response and ease of damping. The 400-cycle test results are shown on Figures 6 and 7. For comparison the response of a rototrol rotating regulator is also shown. The response curves show the difference between reference bus and generator voltage. They were taken by inserting an instantaneous voltage into the reference bus by suddenly switching a battery into the circuit. This test is much more stringent than any mill operating condition but it serves as an excellent measure of control system performance. The response times for full correction are as follows:

	Weak motor field	*Strong motor field*
Rototrol. . . .	0.67	0.3
Magamp. . .	0.1	0.1

It will be noted that the rototrol response is over-damped at weak motor field and under-damped at full motor field. As shown on Figures 5 and 6 of the article "Acceleration Characteristics of Tandem Cold Reduction Mills" there is no overshoot under any operating condition. The response of the Magamp with 75 per cent IR compensation is about 0.1 second and is not greatly affected by motor field strength. With less IR compensation, the response is slightly faster. The system is practically 100 per cent damped even though it is unusually fast.

The curves are based on generator voltage response. The motor speed will follow the voltage in accordance with the mechanical time constant. For further information see the article "Acceleration Characteristics of Tandem Cold Reduction Mills."

The curve on exciter voltage shows why such fast response is obtained. The exciter voltage for the rotating regulator rises to approximately 250 per cent of normal value. With the magnetic amplifier, the power Magamp voltage rises to approximately 465 per cent of normal value in less than one-twentieth of a second—about one-third of the time for the rotating exciter. The time constant of the generator shunt field in both of these tests was approximately four seconds. These tremendous forcing voltages are responsible for the very fast changes in generator field. The performance is amazing when it is considered that in less than one-tenth of a second, the generator field voltage must rise to many times its rated value to force the correction and then return to rated value in order to prevent overshooting.

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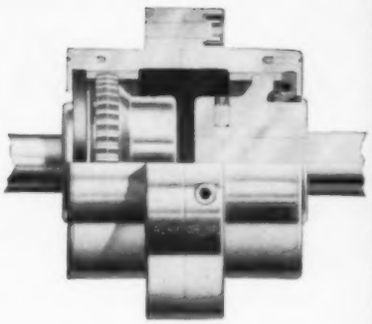

AJAX DEVELOPS NEW DIHEDRAL COUPLING

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WESTFIELD, NEW YORK

J & L POURS FIRST STEEL

From New Melt Shop

▲ Just 17 months and 12 days after breaking ground, Jones and Laughlin Steel Corporation celebrated the tapping of the first heat from new open hearth furnaces at Pittsburgh on October 30. The expansion project includes construction of 11 new open hearths, with an annual capacity of 2,000,000 tons, to be completed by next March. This and other projects in the corporation's five-year $400,000,000 expansion program to be completed in 1952 will increase J&L steel production by 32 per cent.

Features of the new plant include latest developments in open hearth furnace design and use of refractories, instrumentation for high efficiency in the control of temperatures, heat and efficiency of fuel utilization, mechanized material handling facilities, provisions for using tar, oil or gas for fuel, and special facilities for handling scrap.

Since The Pittsburgh Works blast furnaces are located on the north side of the Monongahela river, across from the new open hearths, it was necessary to build a substantial trestlework for delivery of hot metal to the new shop. The track enters the mixer building at high level and continues on into the open hearth lean-to building.

The two new hot metal mixers are of 800 tons capacity each, and are electrically driven. They are charged through the end by inserting a runner spout carried on a movable car, into the end of the mixer. The spout is inserted far enough to prevent the falling stream of iron from striking the lining, thus reducing lining erosion and lengthening lining life. Mixers are equipped with individual burners and fans to provide heat if necessary. In the event of electric power failure while pouring, an emergency air-driven engine returns the mixer to horizontal position. The two-section 150-ton scale at each mixer records and prints the weights. Maintenance is facilitated by a 60-ton crane.

Hot metal is carried from the mixers in 100-ton ladles hauled by a 25-ton locomotive. The ladles are handled at the open hearth by 150-ton overhead cranes which have auxiliary trolleys for dumping the iron.

Special attention was given to the stockyard and scrap preparation layouts because of deterioration in quality of scrap. Scrap is loaded into charging boxes of 44 cu ft capacity at the stockyard and carried on cars of four-box capacity to the lean-to building alongside the open hearths for storage in readiness for delivery to furnaces. The lean-to building is located between the charging floor and the furnace stacks.

The stockyard is equipped with three 10-ton magnet cranes and one 15-ton bucket type crane. The magnet cranes are fast acting units used primarily to unload scrap from railroad cars into charging buggies on the same level. There is a scrap bin running the full length of the loading tracks to permit uninterrupted operation while railroad shifts are being made. This bin is designed to allow separation of types of scrap as required for satisfactory furnace charges. The track layout is arranged to minimize traffic congestion and to provide safe working clearances.

Loaded cars are weighed automatically as they pass over a track scale platform at a predetermined speed governed by a system of colored lights. If this speed is exceeded, the lights change color and the scale becomes inoperative. Weighed scrap is moved into the lean-to building by an 80-ton diesel-electric locomotive.

Fluxes and other additions are at present also supplied to the furnaces from the stockyard. When the 11 furnaces are completed, all raw materials except scrap will be handled in a row of overhead gravity feed bins located alongside the row of stacks. Charge and feed ore, limestone, burnt lime, dolomite, roll scale, etc. will be delivered to these bins over the new trestle connecting the hot metal bridge to No. 4 shop mixers. A mine type locomotive will place buggies on the track running under these bins. After loading, the locomotive will deliver the materials to the lean-to or to the furnaces.

The lean-to building runs the full

March 1950

April 1951

October 1951

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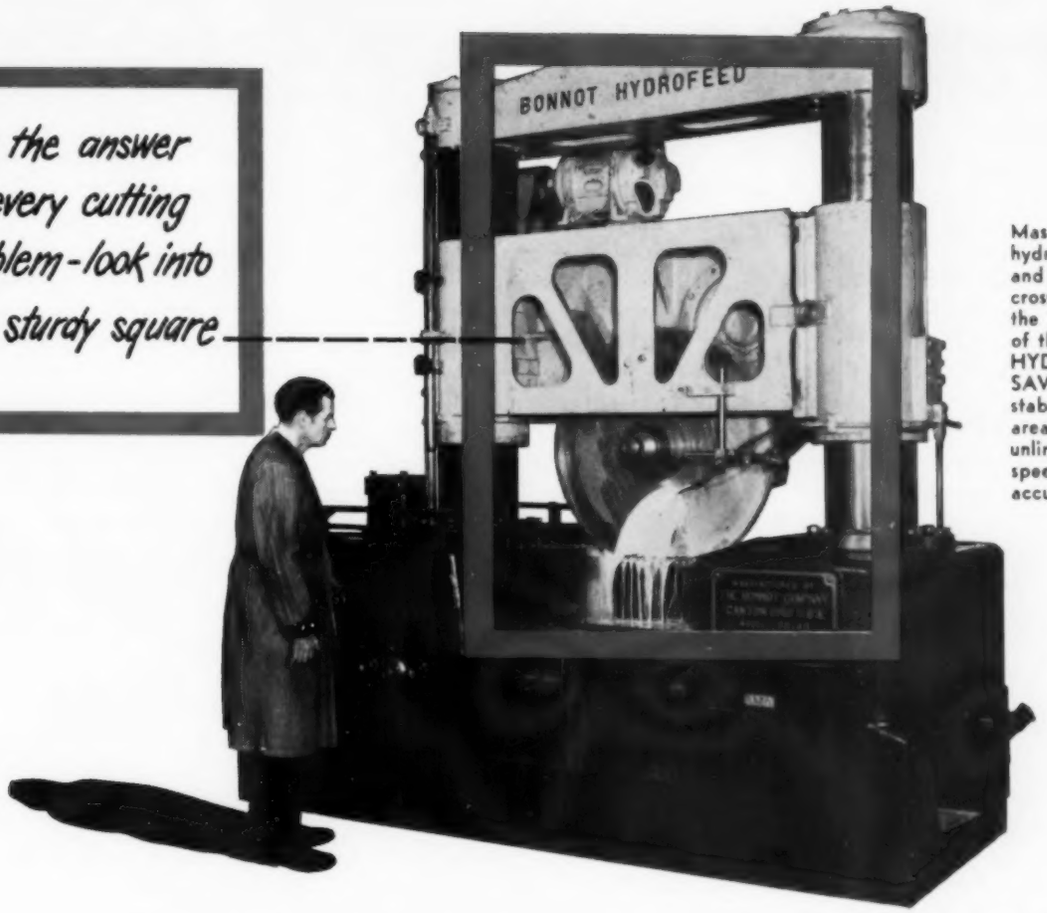

Massive base, huge hydraulic columns and one-half ton crosshead enclose the "sturdy square" of the Bonnot HYDROFEED COLD SAW. This assures stability of working area that means unlimited cuts at high speeds . . . perfect accuracy every time.

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length of the furnace building, 1430 ft long. There are three tracks in the lean-to one for storing loaded buggies, one for unloading ferro-alloys, etc. into floor bins, and the third is the running track. Leads into the charging floor are placed most advantageously to avoid congestion.

The charging floor layout is modern and roomy. Equipment includes the three 150-ton hot metal cranes, previously mentioned, four 12-ton charging machines, and a hot metal track for safe and efficient handling of hot metal to the furnaces. Furnace spacing is adequate for maintenance, as well as providing room for keeping some loaded boxes of burnt lime, feed ore, etc. at each end of most furnaces.

The entire floor will be paved to facilitate the movement of mechanized material handling equipment and a truck ramp with a floor scale is also provided at one end of the floor. Bins for crushed ferro-manganese and ferro-silicon are located at the other end of the charging floor. A special car carrying manganese crushers is located above these bins and the "ladle size" material is discharged into boxes at the pouring pit level. This material is then loaded into smaller bins on the tapping platform of each furnace. A scale is provided on the tapping platform of each furnace, making the weighing of ladle additions much easier than in older shops. The material is weighed in drop-bottom buckets which are then dumped into the ladle addition chutes of each furnace.

Large tote boxes are provided for handling dolomite, magnesite and other bottom making material. These are loaded at gravity feed bins and delivered by buggies. The boxes are fitted with trunnions for handling and dumping by the hot metal cranes so as to lighten manual work effort.

Charging tracks in front of the furnace doors were specially designed to prevent spills sticking as they do under the head of standard rail. Rails are manganese, non-magnetic castings without heads. This effort to eliminate the manual effort of cleaning spills from old style rails is believed to be well worth the extra cost. Its performance will be closely watched by the rest of the industry.

The furnaces, of 250 tons capacity, are provided with basic ends. Each furnace rests on two main concrete piers, the inside faces of which extend to form a base for the front flush buggy in which the cinder pot is carried. The slag chute leads down through the charging floor to the cinder pot below the center door of the furnace, and serves to direct the flow of "flush off" slag into the pot. The buggy also moves the slag pot into position under the tapping spout so it can catch the slag when the furnace is draining after tapping.

Furnace body and uptakes are streamlined, with critical areas such as the knuckle, uptakes, fantails and flues designed for proper flow of incoming and outgoing gases. Slag pockets are large and fitted with sloping false walls to a height of 4½ ft to facilitate removal of slag pocket deposit.

The basic brick ends withstand higher operating temperatures than conventional silica brick construction and thus permit longer periods of operation before replacement. A suspension arrangement allows patching without disturbing the walls either above or below the patched area. The heavier weight of basic bricks and their lower load carrying qualities at high temperature require heavy steel supporting structure and a system of suspending brackets. Brackets are arranged in horizontal rows and usually carry four or five courses of brick, thus reducing the superimposed load on any row of basic brick. Port roofs, also of basic construction, are suspended to a point extending over the bridge walls.

Main roof construction is the conventional ribbed arch, made up of 15-in. and 18-in. deep ribs with every fifth rib high. Drop sections in the front and back of the roof provide added thickness in these hot working regions.

The bottom consists of a thin layer of insulating material next to the pan plates, followed by 18 in. of basic brick on which is placed 16 in. of rammed refractory material. The top covering is burnt-in grain magnesite, 8 in. deep. This gives a total bottom lining of 42 in. exclusive of the insulating layer. The end slopes of the furnace pan plates over the wind box are kept low in order to allow expansion of the bottom material during the installation and heating up. Lower slopes also permit greater thickness of bottom material at the top of the wind box, a weak spot in many furnace designs.

Aerial view along the south bank of the Monongahela River shows part of the Jones & Laughlin Steel Corporation Pittsburgh Works, which covers 276 acres. Outlined are the $70,000,000 new open hearth furnace expansion area and new rail classification yards.

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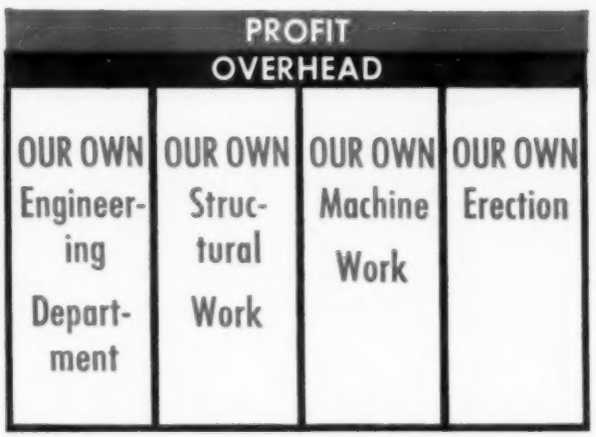
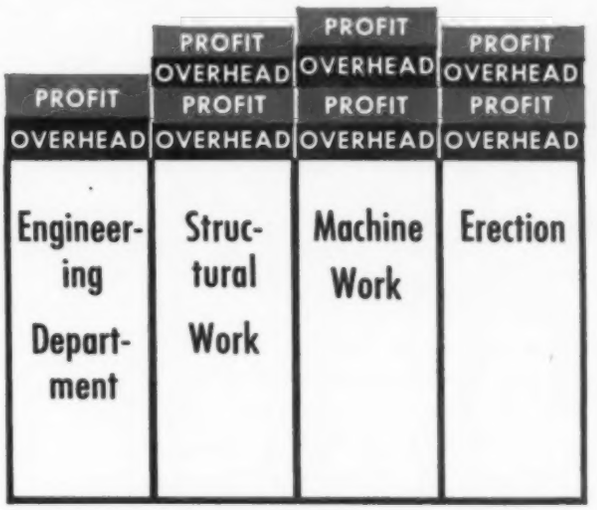


In Contrast With Other
Many Overheads...Many Profits Way



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The back wall is of sloping type, basic brick construction and sheathed in steel plates. The front wall consists of metal-clad basic brick to a thickness of 18 in. with each second course of brick tied into the furnace binding. Front buckstays are water-cooled and archless door frames are used. There are five large doors, lined with rammed material and electrically operated.

Checkers are of ample size, well laid out and set up to allow blowing during operation. Flues are streamlined as much as possible and arranged for adequate servicing during repair. Furnace stacks are 250 ft high.

The large bath area of 1050 sq ft and a bath depth of 31½ in. make for a fast working furnace. This area gives a nearly ideal ratio of 4.2 sq ft per ton capacity. The depth allows rapid penetration of heat to get quick start of reactions.

The furnaces are equipped to burn both liquid and gaseous fuels in combination and instrumentation is the most modern design. Controls are arranged to handle oxygen for combustion and will regulate the total amount of oxygen that is introduced into the furnace from straight air or any combination of air and oxygen. Instruments and controls for each furnace are mounted on a panel board enclosed in an individual control house. Fuel storage and pump house are at the extreme up-river end of the plant. Four tanks of 2,100,000 gallons total capacity will store fuel oil and topped tar unloaded from barges, railroad tank cars, or motor trucks. Separate circulating systems are provided for fuel oil and tar. Fire protection is provided by an automatic extinguishing system.

The pouring pit runs the full length of the furnace building and is served by three ladle cranes of 350 tons capacity and almost 70 ft span. A broad gauge debris track is provided in addition to pouring tracks. Three pouring platforms are respectively 277 ft, 497 ft and 277 ft long, and 13 ft wide. All are equipped with bins and scales for storage and weighing of mould additions, such as aluminum and ferro-silicon. Traveling jib cranes of one-ton capacity serve these platforms, particularly for capping rimmed ingots. All necessary utilities such as water, gas oxygen, acetylene and electricity are available at several points on each platform.

By far the greater portion of the ingot run is under roof. The tracks are arranged for minimum interference of movement. Hot topped ingots will pass through the mold preparation building for hot top removal on their way to the stripper. On their return from the blooming mill the molds will pass through the building on the opposite side of the platform, where they are prepared for the next heat. As a safeguard against delay caused by derailment, there are two leads into the stripper building.

Two 400-ton capacity stripping machines, the largest built so far, are of low type with telescoping screws, avoiding hazardous counterweights. Other facilities in the stripper building include equipment for cooling ingots and moulds, stripping stool stickers, removing ingot butts, and changing and cleaning stools.

The mould yard and cinder yard are parallel to the furnace building, both areas being served by a common crane runway 1070 ft long with four cranes. The mold yard is under a roof. All of the slag is to be crushed and sent to the blast furnaces or slag disposal plant from the cinder yard. All molds and stools for No. 4 shop will be stored in this mold yard.

All major points in the new shop are interconnected by means of a public address system, while a telautograph system connects the shop with the blast furnaces, the mixers and the chemical laboratories.

BUREAU OF MINES CIRCULAR DISCUSSES FROTH FLOTATION PROCESS

▲ Froth flotation, a process widely used for recovering mineral substances from finely ground ores, has been adopted for the preparation of very fine coal more widely in Europe and Britain than in this country, according to a Bureau of Mines circular.

The process, by which material such as fine coal is caused to float by bubbles of air forced upward through the flotation machine while the ash and other impurities sink, is attracting more interest in domestic coal circles because its use makes it possible to recover much good coal that other types of preparation equipment discard with the refuse. The circular, giving cost and operating data on three flotation plants in the Netherlands and seven in Great Britain, was prepared by three Bureau of Mines coal technologists on the basis of their observations while on a foreign assignment during the summer of 1950.

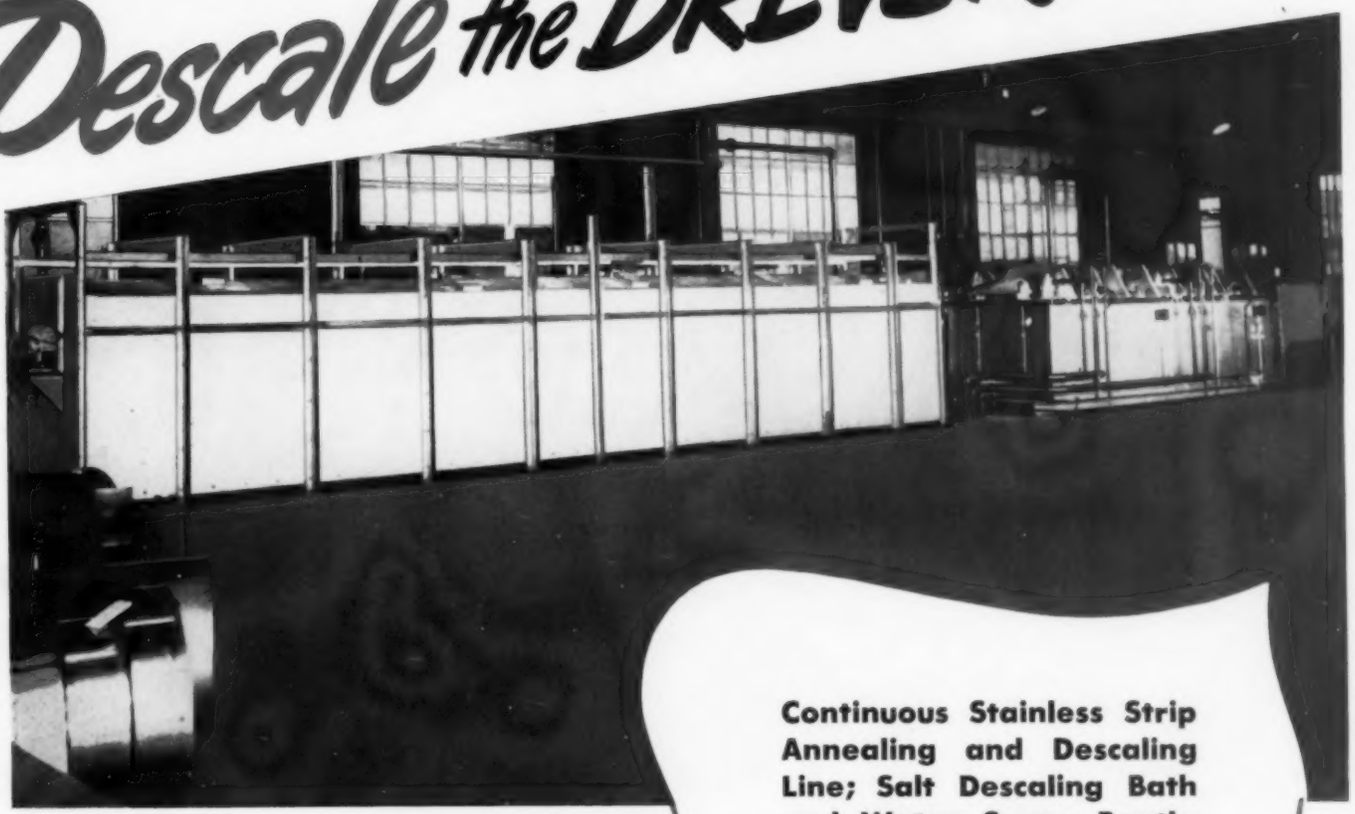
The circular notes that froth flotation has been adapted to coal preparation more widely in Europe than in this country, and that in some respects European practice is in advance of ours. In 1950, there were about 16 froth flotation plants operating in the Ruhr area of Western Germany, three at the Dutch State Mines in the Netherlands, and 43 in Great Britain, as well as a number in the Saar Basin and other areas of France.

Besides presenting detailed data on the 10 plants mentioned, the report discusses general trends and developments in British and continental coal froth flotation practice. Among the principal differences from American practice are mentioned the trends toward closed washery circuits, flocculation of flotation tailings with return of clear water to the circuit, and the almost universal use of coal tar products as flotation reagents instead of the petroleum oils and pine oil extensively used in this country.

The report was prepared by B. W. Gandrud, chief of the Fuels Technology Division of the Bureau's Region VII at Tuscaloosa, Ala., Thomas Fraser, coal technologist at the Bureau's Washington, D. C. headquarters, and H. F. Yancey, chief of the Fuels Technology Division of the Bureau's Region II at Seattle, Wash.

A free copy of Information Circular 7614, "Froth-Flotation Practice in Coal-Preparation Plants of Western Europe and Great Britain," can be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pa.

Descale the DREVER way *



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Alan Wood Steel Installs Mill Scale Recovery Plant

By R. F. COLTART
Engineer, Sanitary Engineering Dept.
Link-Belt Co.
Philadelphia, Pa.

▲ Alan Wood Steel Co. at Ivy Rock, Pa., recently placed in operation an industrial waste treatment plant in compliance with the Commonwealth of Pennsylvania's stream pollution abatement program.

Cooling water from the company's blooming mill, plate mill and strip mill operations contains iron oxide (mill scale) and oils. Originally, this waste water was discharged into the Schuylkill River without treatment. With the installation of the new facilities, the water is recirculated after treatment. Make-up water is added from the river to replace cooling water used for the open hearth furnaces. The cooling water from these furnaces is not contaminated, and it is discharged back to the river without treatment. Scale pits are used with each machine in the various mills, and it is the overflow from these pits that is collected in a common sewer and brought to the plant for treatment.

After passing through a Parshall flume, the waste water passes through an oxide concentrator 20 ft-0 in. wide by 12 ft-0 in. water depth by 74 ft-0 in. effective horizontal settling length. This tank is designed to provide a detention period of about 8 minutes at the design flow of 13,000 gpm.

The oxide concentrator is equipped with two Link-Belt Co. flight type collectors, which convey the settled scale along the horizontal bottom of the tank and then up the inclined end of tank. Each collector consists of a double strand of combination type chain with 6-in. steel channel flights at 5 ft-0 in. centers, and it operates at a speed of 2 fpm. A mechanical flight wiper is provided to assure discharge of the scale into boxes for easy removal by truck.

Figure 1 — General view of oxide concentration tank and circular settling tank.

Figure 2 — Oxide concentration tank contains two collectors (conveyors) for removing rolling mill scale from 13,000 gpm roll cooling water. Detention period is about 8 minutes.

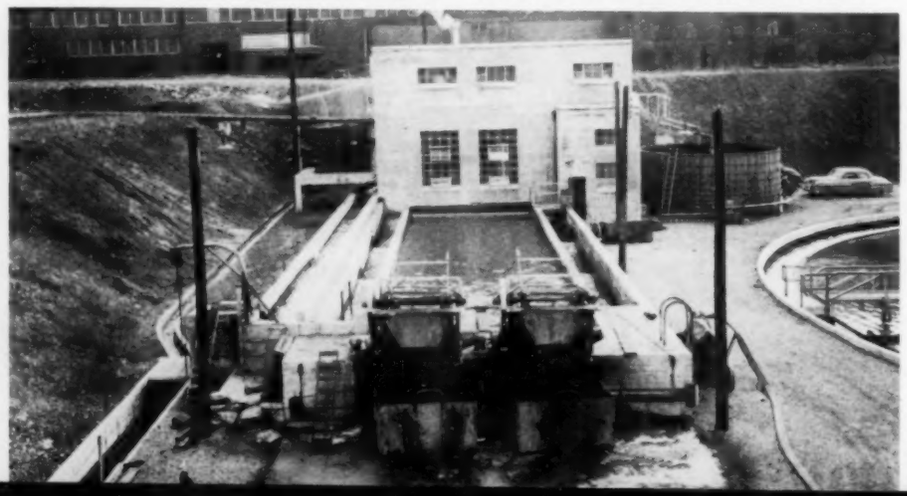
A 12-in. diameter, worm gear operated, Rotoline skimmer at the effluent end of the tank is used to skim floating oil from the water surface.

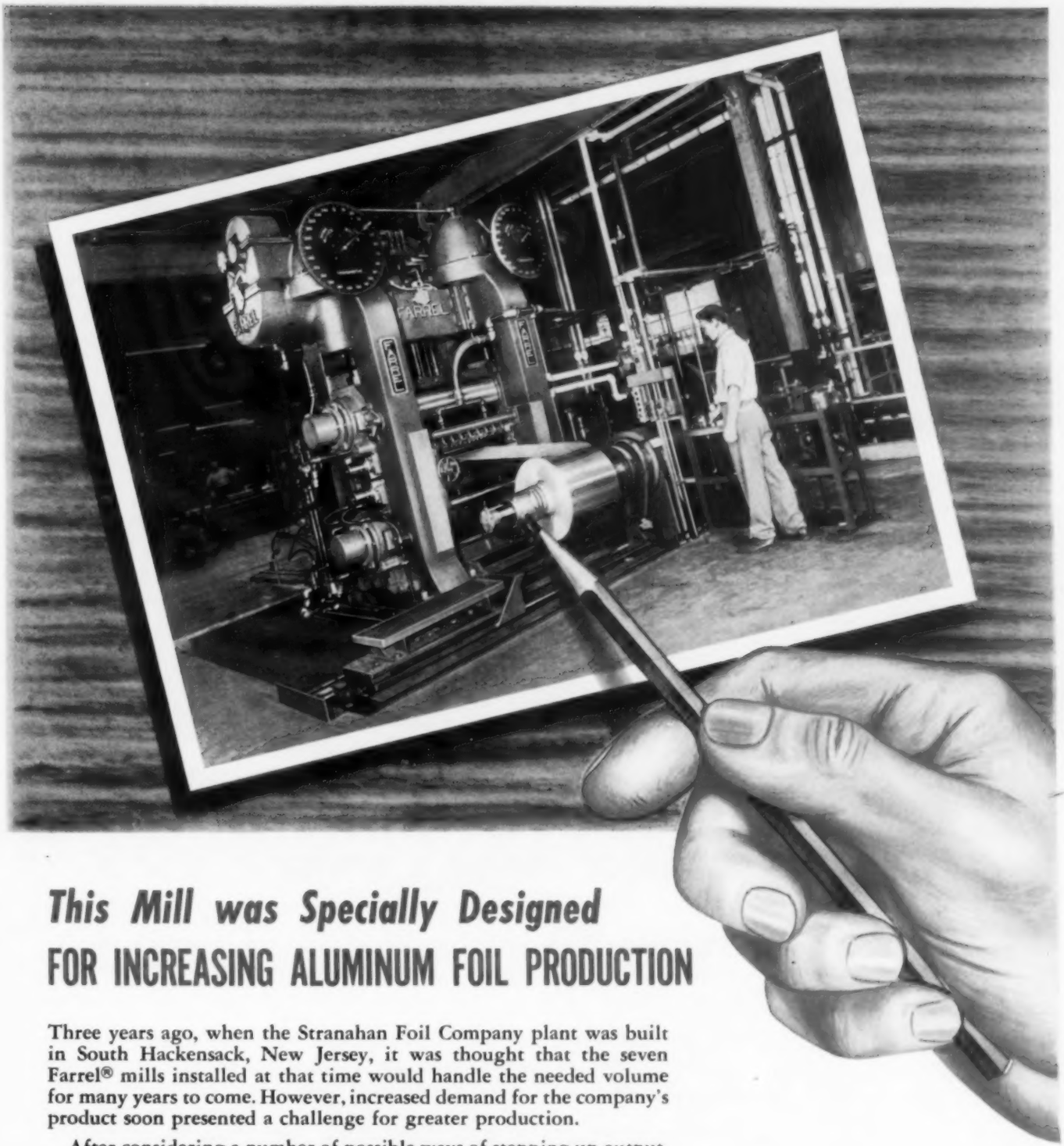
The effluent from the oxide concentrator passes through two concrete channels (where a rippling effect is produced for aeration purposes) to a mixing well where make-up water from the river is added as required.

The water then passes through a circular settling tank, 125 ft-0 in. diameter by 13 ft-0 in. side water depth, for the removal of fine suspended solids and light oils. This tank, which provides a detention period of approximately one hour at the design flow of 17,000 gpm, is equipped with plow type sludge collector.

The effluent from the circular settling tank passes to a pump station which returns it to the mill for re-use. The mill scale recovered by the oxide concentrator is reprocessed. Sludge from the circular clarifier and the recovered oils are disposed of in a large lagoon. Frederick H. Dechant, consulting engineer, designed this waste treatment plant, which was built by United Engineers & Constructors, Inc., of Philadelphia, Pa.

Figure 3 — Two collectors discharge mill scale into containers at end of tank.





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The new mill has 9" x 46" work rolls and 21" diameter backup rolls. All four rolls are forged tool steel, precision ground and crowned to meet requirements. A double motor screw-down provides for precise adjustment of either roll end independently or the simultaneous adjustment of both. The speed of mill operation can be varied to meet a wide range of production requirements by means of an adjustable voltage control system.

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Date-line Diary...

October 1

▲ According to the AISI, the operating rate of the steel industry is scheduled at 102.6 per cent of capacity for the week beginning October 1. This is equivalent to 2,051,000 tons of steel ingots and castings compared with 2,041,000 tons one week ago.

▲ Algoma Steel, Ltd. awarded Rust Furnace a contract to furnish a new billet heating furnace and three complete batteries of soaking pits for its works at Sault Ste Marie.

October 3

▲ Iron ore shipments down the Great Lakes amounted to 12,671,805 tons bringing the total for the season to 71,516,546 tons. September shipments were slightly under the all-time record.

▲ OPS set price ceilings on imports of lead and zinc. Domestic ceilings on these two items were raised 2¢ a lb to 19¢ for lead and 19½¢ for zinc.

▲ Treasury Secretary Snyder reported that the government went $2,614,000,000 into the red for the quarter ending September 30. This is the largest quarterly deficit in history except during the years of World War II.

▲ Stockholders of Allegheny Ludlum Steel will meet December 4th to consider increasing company's indebtedness from $20,000,000 to $40,000,000. Allegheny Ludlum will also consider offering about 81,000 shares of convertible preferred stock.

October 5

▲ American Railway Car Institute reports domestic freight car deliveries in September totaled 8533. Orders for new cars totaled 9657 leaving a backlog of cars on October 1 at 140,135.

▲ General Electric Co., in an agreement with the CIO electrical workers, raised wages a minimum of 3½¢ an hour thus averting a threatened strike of 70,000 workers in 55 plants.

October 6

▲ NPA ordered increases in the amount of steel which producers must ship to warehouses after January 1.

October 8

▲ Based on reports from companies having 93 per cent of the steel capacity of the industry, the operating rate for the week beginning October 8 is scheduled at 101.8 per cent. This is equivalent to 2,035,000 tons of steel ingots and castings compared with 2,051,000 tons one week ago.

October 10

▲ Republic Steel's No. 5 blast furnace set a new production record for this furnace in September producing 48,005 tons of steel.

▲ Bureau of Statistics reported that Canadian steel ingot production in August totaled 277,752 tons compared with 275,099 tons for the same month one year ago.

▲ The Council of Economic Advisers reported that total production of goods and services in the third quarter ran at a record annual rate of $328,000,000,000. Corporate profits, however, dipped to $46,500,000,000 down $2,000,000,000 from the June quarter.

▲ The NPA announced that aluminum supplies will be taken from stockpiles to fill fourth quarter allotments.

▲ Sharon Steel Corp. registered 174,137 additional common shares with the SEC.

October 11

▲ NPA announced that the government will try to allocate auto makers enough steel, copper and aluminum to produce 950,000 passenger cars in the first quarter of 1952. This is a cut of about 13.6 per cent from the last quarter of 1951.

▲ Edison Electric Institute predicts that utilities will be able to meet all defence and civilian power demands this winter, although there may be spot shortages.

October 12

▲ Leaders in the steel industry told Defense Mobilizer Wilson that they plan to ask the government to approve an increase in steel prices.

▲ The AISI reports that hourly payments to wage earners in the iron and steel industry averaged $1.931 in August, an increase of 21.4¢ an hour over August 1950. Wage earners averaged 40.4 hr a week in August. The total payroll in August was $246,670,000. Total employment was 679,100 for a new record.

October 13

▲ DPA predicted that consumer durable goods manufacturers will get 50 to 60 per cent of their 1950 steel supplies in the first quarter of 1952.

▲ Admiral Ben Moreell, president of Jones & Laughlin Steel Corp., predicted that steel prices will have to be raised if wage demands of the CIO are to be met.

▲ Price boss DiSalle stated that no applications for price boosts have been received from the steel industry.

October 15

▲ British Steel production in September was equivalent to a rate of 15,749,000 tons compared with 16,964,000 tons for September 1950. Production is being kept down due to shortages of iron ore and scrap. Pig iron output in September was at an annual rate of 9,854,000 tons compared with 9,409,000 tons for August 1950.

▲ Based on reports from companies having 93 per cent of the steel capacity of the industry, the operating rate is scheduled at 102.1 per cent of capacity for the week beginning October 15. This is equivalent to 2,041,000 tons of steel ingots and castings compared with 2,035,000 tons one week ago.

▲ Newport Steel Corp. will start work immediately on a $22,460,300 expansion and rehabilitation program. Project includes new buildings, electric furnaces, a continuous pickling line, cold reduction mill and material handling facilities.

October 16

▲ Striking employees of the Brier Hill open hearth plant of Youngstown Sheet & Tube went back to work.

October 18

▲ Colorado Fuel and Iron Corp. are taking steps to acquire the assets of E & G Brooke Iron Co. which operates an iron mine at Wharton, N. J. and a blast furnace at Birdsboro, Pa.

▲ Rail equipment makers will get only enough steel,

copper and aluminum for the first quarter of 1952 to build 800 locomotives and 21,450 freight cars.

▲ Frederick O. Hess, president of Gas Appliance Manufacturers Association, proposed that gas conversion plants be constructed along existing natural gas pipe lines to utilize nearby coal reserves.

▲ DPA administrator Manley Fleischman and, director of ODM, Charles E. Wilson agreed on the termination of a 60 day moritorium on the issuance of tax amortization certificates. A new procedure and criteria for filing and processing of applications were also announced.

▲ Workers of Inland Steel, which had been on strike since last Monday, went back to work today.

October 19

▲ Sheffield Steel Corp. awarded the Koppers Co. a contract for a battery of 50 new by-product coke ovens at its Houston, Tex. works.

▲ The AISI reports that total shipments of steel for the first eight months in 1951 totaled 52,700,000 tons or 6,200,000 tons more than the same period in 1950. This is an increase of 13 per cent. Direct military shipments of steel totaled 667,000 net tons. Automotive steel totaled 8,900,000 tons or a decrease of 7 per cent.

October 20

▲ The House approved a new tax bill which will increase federal revenues by $5,691,000,000 by a vote of 185 to a vote of 160. Capital gains tax rate goes from 25 to 26 per cent.

▲ The railroads asked the ICC to reconsider its recent decision on freight rate increases and grant the full 15 per cent boost which was previously requested.

October 22

▲ Based on reports from companies having 93 per cent of the capacity of the industry, the operating rate of the steel industry is scheduled at 102.9 per cent capacity for the week beginning October 22. This is equivalent to 2,057,000 tons of steel ingots and castings compared with 2,041,000 tons one week ago.

October 23

▲ The Aluminum Association reports that primary output for August totaled 147,630,992 lb. Aluminum sheet and plate shipped totaled 91,888,728 lb in August.

▲ Allegheny Ludlum Steel Corp. reports sales for the third quarter of 1951 of $54,144,807, and net earnings of $2,213,161. This is equivalent to $1.36 per share of common stock.

▲ The OPS boosted ceilings on lead and zinc scrap as much as 2¢ a lb.

October 24

▲ The Office of International Trade announced that they will be able to approve only the most urgent requests for steel exports starting January 1952.

▲ The Government boosted price ceilings in iron and steel scrap by $2.00 a ton. This covers so-called nonproduction or unprepared scrap. In addition the OPS switched ceilings on several grades of open hearth iron and steel scrap.

October 25

▲ Sharon Steel Corp. reported net income for the third quarter of $2,163,061 on total revenues of $40,389,106. Income for the first nine months totaled $7,216,005 or $7.79 a share compared with $6.69 for the same period in 1950.

October 26

▲ Eugene Grace, chairman of Bethlehem Steel Corp., reported September quarter earnings of $18,460,372 or $1.76 a share. This compares with $3.33 a share in 1950. Taxes were the major factor in the decrease.

▲ ICC authorized the Railway Express Agency to increase rates 11 per cent.

▲ Republic Steel Corp. reported a net profit of $12,496,763 on total revenues of $258,109,983 for the quarter ending September 30. This is equivalent to $2.05 a share compared with $3.10 a share for the corresponding quarter of 1950.

▲ F. W. Dodge Corp. reports total contract awards for September of $1,082,855,000 or 14 per cent down from August for the 37 states east of the Rockies.

▲ The AISC reports September bookings of structural steel total 188,013 tons or 11 per cent below the previous month. Shipments during September totaled 229,299 tons. The total backlog available for fabrication in the next four months is 1,085,593 tons and the total potential backlog is 2,580,345 tons.

▲ Youngstown Sheet and Tube Co. reports net income of $7,194,334 for the third quarter. Net sales and other revenues totaled $366,056,435.

October 29

▲ According to the AISI, the operating rate for the steel industry for the week beginning October 29 will be 104.5 per cent of capacity. This is equivalent to 2,089,000 tons of ingots and castings compared with 2,057,000 tons one week ago. This is the largest amount of steel ever to be made in one week in the United States.

▲ Youngstown Sheet & Tube Co. is planning an additional $40,000,000 expansion at its Indiana Harbor, Ind. plant. New program includes a 56-in. cold strip mill and a fourth heating furnace.

▲ Armco Steel Corp. reported earnings today for the third quarter of $6,094,354 after taxes and preferred dividends. This is equivalent to $1.17 per share compared with $3.03 per share for the same period in the previous year.

October 30

▲ Woodward Iron Co. awarded Rust Engineering Co. a contract to engineer and build an addition to the Woodward, Ala. boiler plant.

▲ Defense Department reported that it had placed orders for the third quarter totaling $9,100,000,000.

▲ United States Steel Corp. reports income for the third quarter of 1951 of $27,936,060 or 83¢ a common share compared with $2.04 for the same period in the previous year.

▲ The CIO United Steelworkers are sending contract termination notices to the producers effective December 31. This is preliminary to negotiations for new wage pact.

October 31

▲ The Jones & Laughlin Steel Corp. reported earnings of $8,101,000 or $1.25 a share on total revenues of $136,438,000 for the quarter ending September 30. This compares with a net income of $11,233,000 for the same period in 1950.

▲ Inland Steel Co. reports net income for the quarter ending September 30 of $7,748,751 or $1.58 a share compared with $1.85 a share for the same period in 1950. Total sales were $131,229,602.

▲ United States Steel Corp. increased prices of galvanized products approximately 1/8¢ per lb reflecting the increase of 2¢ per lb in the price of zinc.

▲ Steel prices in France will be raised about 22 per cent. This is due to an increase of 15 per cent in wages and a 20 per cent increase in coal prices.

▲ Negotiations between the RFC and tin producers in Bolivia ended. Bolivians are holding out for $1.50 per lb while RFC refuses to go higher than $1.12 a lb.

▲ National Steel Corp. reports net earnings for the third quarter of $10,585,971 or $1.44 a share compared with $1.91 a share for the same period of 1950.

NOW You Can *See* Where You Can't *Look*

Eliminating Hazards and Reducing Costs

IN STEEL MAKING with the

DIAMOND "UTILISCOPE"

(WIRED TELEVISION)

Continuous casting of billets is a process which promises very important reduction of steel making costs. Formerly, a man had to stand close to the stream of molten steel watching the surface of the metal in the mold and always ready to signal the operator 50 feet away. The hazard was great and discomfort from radiant heat quickly became unbearable.

Now, a "Utiliscope" (wired television) camera with a long focal length lens is placed above the metal surface. The viewer is placed at the control panel. The operator can see everything that happens at close range in comfort and safety . . . can watch more effectively than a man close to the molten steel.

This is one of the many applications where the Diamond "Utiliscope" promotes safety . . . improves operation . . . saves labor. The "Utiliscope" extends the power of the eye so you can see around corners, through walls, into fire and through water. It is simple and easy to use. Installation requires no special skill. Adjustment of focus, brilliance and contrast is quickly and easily made.

You may have a place where the "Utiliscope" will save you money, or solve a difficult problem. Write for Bulletin 1025 with complete description; it suggests many possible uses.

OTHER USES

- **Studying destructive tests of engines**
- **Checking remote gage readings**
- **Observing conditions inside furnaces**
- **Viewing nuclear research**
- **Coordinating material flow on conveyors**

The "Utiliscope" (Reg. U. S. Patent Office)

WRITE FOR BULLETIN 1025 E

DIAMOND POWER SPECIALTY CORP.
First in Industrial Television
LANCASTER, OHIO
DIAMOND SPECIALTY LIMITED
Windsor, Ontario

Since 1903, Diamond has Manufactured Quality Equipment for Industry

This is just one way in which **"Utiliscope"** can serve the steel industry

Not only does the "Utiliscope" enable an operator to watch hot pouring operations in safety and comfort, this wired television equipment permits seeing things which previously couldn't be watched at all. Many additional possibilities will occur to you out of your familiarity with the steel industry.

Send for Bulletin 1025E. It is thought provoking on ways the "Utiliscope" can save you time and money, improve operation, increase safety. Write to Department "E."

DIAMOND POWER SPECIALTY CORP.

Department "E"

LANCASTER, OHIO

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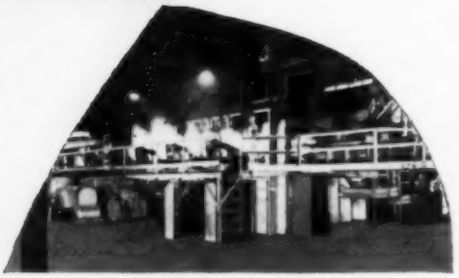
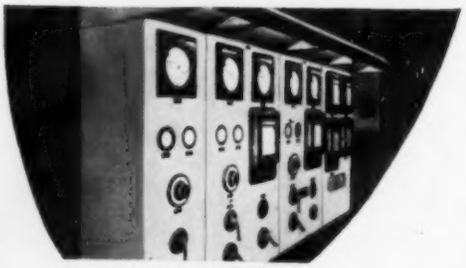
F.E.I. serves industry both here and abroad . . from plan to production · · Open Hearth Furnaces, Soaking Pits, Continuous Reheating Furnaces, Forging Furnaces, Annealing and Normalizing Furnaces, Galvanizing Furnaces and complete heating lines for all kinds of armament — guns, armor plate, shells, etc.



View of slab entrance end.

Side view showing patented Burners.



Instrument panel of automatic controls.

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8

Industry News...

COLORADO FUEL AND IRON CORP. HAS UNUSUAL BLAST FURNACE REPLACEMENT

▲ An unusual blast furnace replacement operation at Minnequa works of Colorado Fuel and Iron Corp. to increase iron production of this Pueblo, Colo. plant was recently completed.

To keep the old furnace in operation turning out basic iron until the last possible moment, a new furnace shell was constructed on a temporary steel under-structure alongside the old furnace. When the shell was completed, the old furnace was shut down and turned over to crews of Affiliated Furnace, Inc.

These crews ripped out brick between old shell and foundation, replaced three of eight steel supporting columns with wooden timbers, inserted dynamite in timbers. At same time other men attached steel cable to the top of furnace, and tied the other cable end to a steam locomotive in the plant yards. The locomotive pulled cable taut, with the direction of the pull in line with the center of the three wooden timbers. At a given signal, the locomotive started tugging on the cable, and dynamite in timbers was set off. The whole structure came tumbling down as shown in the illustration.

All the work had to be exact and correctly timed, for the furnace had to fall in a comparatively small area between other existing structures without harming the latter. The big advantage of the demolition operation, was in time. It was a lot faster than the conventional method of dismantling a furnace piece by piece.

Once the old furnace was down, the new 350-ton steel shell and top structure, towering 159 ft in the air, was skidded 100 ft onto the old foundation. Everything was ready at the site to get the new furnace into production as quickly as possible. Affiliated crews replaced damaged foundation, lined the new shell with 1000 tons of heat-resistant brick and completed remaining structural work. After final fitting-up, the new furnace was dried out and put into service.

The whole job, from the time the old furnace was shut down and turned over to Affiliated for razing, until the new furnace is completed, is expected to require only 100 days. Thus, interruption to iron production for vitally-needed steel is held to a minimum.

One of four blast furnaces at the Minnequa works, the replaced furnace was first "blown in" on September 4, 1901 and had produced 4,621,434 tons of basic iron for open hearths, merchant iron, malleable and foundry iron, and ferro-manganese. It had been reinforced and relined 9 times. The new furnace will produce 700 tons of iron every 24 hours. Capacity of the old furnace was 500 tons.

Also included in the rebuilding operations were a new automatic skip hoist, and a new cast house.

The work had to be exact and correctly timed, for the furnace had to fall in a comparatively small area between other existing structures. The big advantage of this method is the saving of dismantling time.

YUGOSLAVIA TO RAISE STEEL CAPACITY BY 25%

▲ The government of Yugoslavia has ordered complete electrical equipment from the Westinghouse Electric International Co. for two iron ore sintering plants that will boost the capacity of that country's two largest steel mills by 25 per cent.

In addition to supplying the electrical equipment, Westinghouse also will coordinate purchase of mechanical equipment from about a dozen American suppliers for the new plants. Additional apparatus for the units will be made in Yugoslavia.

The new sintering plants are expected to increase the capacity of the huge steel mills at Sisak, in Croatia,

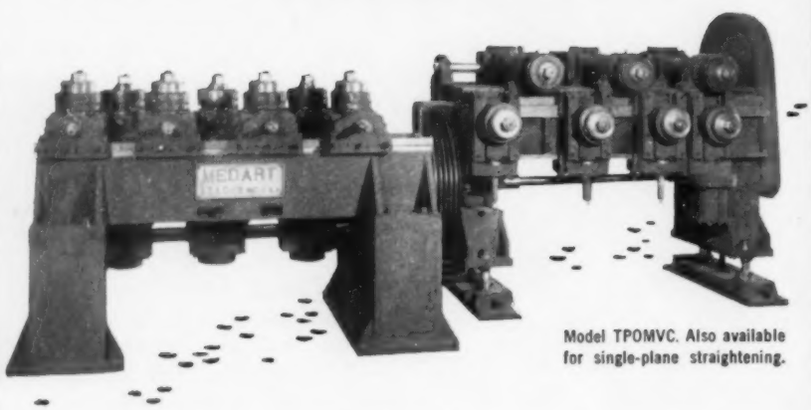
Versatile! Variable Centers!

Faster Straightening Of An Extreme Range Of Shapes On This New Machine

MEDART

Two-Plane–Overhung Roll–Variable Center

SHAPE STRAIGHTENER



Model TPOMVC. Also available for single-plane straightening.

- Combines the fast, simple setup advantage of an overhung roll straightener, with exceptionally versatile control of bending stresses possible only in a movable-roll center type of machine.
- Variable center roll housings permit adjustment of bending spans for handling an extreme variety of shapes and sizes. This feature prevents overloading of bearings and assures uncommon accuracy.
- Bottom rolls can be moved directly under top rolls for cross-rolling or reforming cross sections of distorted extruded or other shapes simultaneous with straightening action.
- Top and bottom rolls, when set in opposing pairs, act as additional pinch-feed rolls for extra traction required for difficult-to-straighten shapes.
- Rolls are quickly and easily changed by removing locknut on end of each shaft.
- Rolls are of Medart Smavroc alloy steel hardened and ground to shape ... All gears operate in oil within enclosed housings ... Pinch-feed rolls at end are air-operated. Timken bearings throughout.

Write For Complete Details

THE MEDART COMPANY 3535 DE KALB STREET ST. LOUIS 18, MISSOURI

and at Zenica, in Bosnia, because they will permit processing larger quantities of iron ore in each blast furnace charge. The sintering process reduces by 25 per cent the amount of coke required by the furnaces.

The new apparatus will add upwards of 75,000 tons of steel to the annual capacity of Yugoslavia's blast furnaces, believed at present to be between 400,000 and 500,000 tons. It is expected that they will more than repay their cost during the first year of operation.

Electric equipment being supplied by Westinghouse includes gear-motors and direct-connected motors in capacities from 5 to 700 hp, together with their controls. Four of the largest motors will drive fans to blow hot air through ore sintering pans. Eleven fans for cooling the sinter and for dust collection will have capacities ranging from 10,600 to 23,500 cfm.

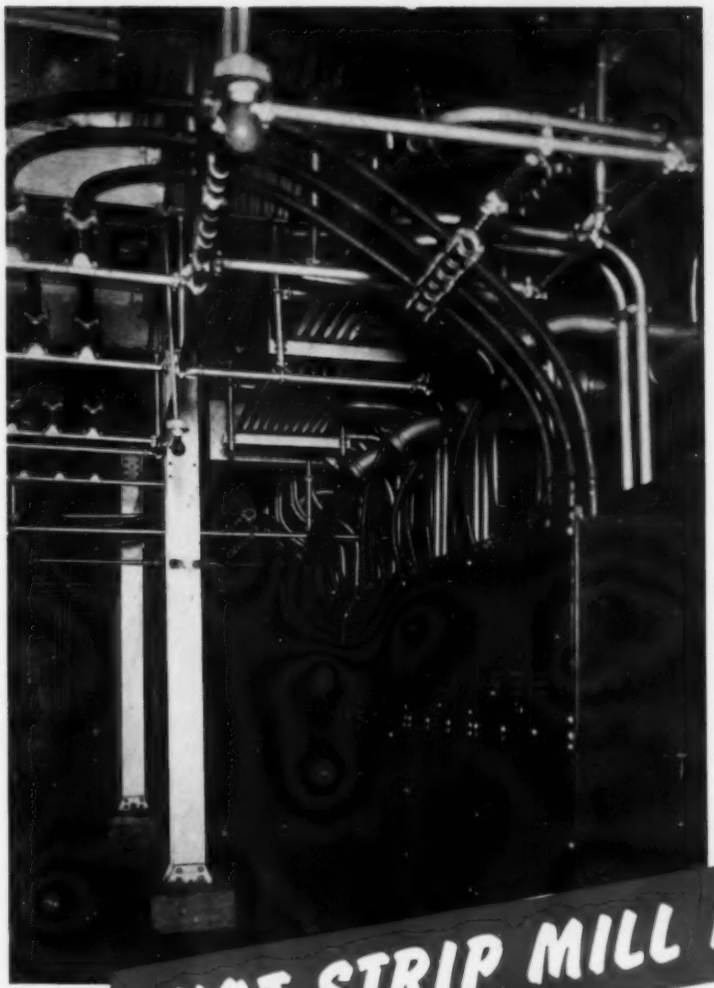
B.& L.E. RAILROAD BUYS 500 NEW 70-TON ORE CARS

▲ A substantial increase in the flow of iron ore from the Mesabi Range to mills in the Pittsburgh district will be virtually assured when the Bessemer and Lake Erie Railroad puts the first of 500 new 70-ton ore cars into service early next year.

The new car order, which was awarded to the Greenville Steel Car Co., by the railroad this week, is expected to strengthen the water-rail and possibly the all-rail movement of ore.

Fred W. Okie, president of the Bessemer and Lake Erie, who announced the awarding of the contract said: "Additional lake carriers of ore will be ready for service in the spring of 1952. This means that there should be more ore moving on the lakes to supply the increasing demands of the furnaces. The railroad must increase its ownership of equipment to handle the increased ore traffic. Additionally, it is not possible to move all of the ore during the period of open navigation, and much of it must be moved to the blast furnaces on a year-round basis."

These new cars with a special type of door in the bottom, facilitate the unloading of ore, limestone and other heavy commodities. They were especially adapted for this main-line, long-haul service by redesigning the standard ore car used in short-route service



WHY IS OKOLITE-OKOPRENE THE CHOICE FOR HOT STRIP MILL POWER CIRCUITS?

HERE ARE SOME OF THE REASONS:

The Okoprene sheath, containing no rubber, will not rot or deteriorate when subject to moisture in underground service. It has better resistance to acids, alkalies, corrosive chemicals — and especially oils — than braid, lead, or other common cable coverings. Will not deteriorate at heats even as high as 167°F. Okolite-Okoprene cables do not require a lead sheath.

The Okolite insulation resists moisture and heat to virtually the same degree as the Okoprene sheath. Millions of feet of Okolite-Okoprene cables, under the toughest service conditions, have proved their superior insulating strength, aging properties and stability.

Okonite cables are the only cables on the market on which the insulation and sheath are applied by the strip process. This method of application makes a profound difference in the cable's endurance. For instance, the insulation is not "worked" as it must be for the extrusion method; insulation and covering are applied in one operation and vulcanized but once; a much more dependable bond between the two is thus obtained.

Most conclusive evidence of Okonite cable superiority is the a-c and d-c super-voltage testing routinely applied during its manufacture — the highest voltage cable testing in use anywhere. No other cable manufacturer offers this positive assurance for trouble-free service.

Much of the $50,000,000 worth of electrical equipment to go into steel mills this year will be served by Okonite wires and cables. Bulletin IS-1053 gives *all* the reasons why. Write for this bulletin today, to The Okonite Company, Passaic, N. J.

OKONITE SINCE 1878

THE BEST CABLE IS YOUR BEST POLICY

insulated wires and cables

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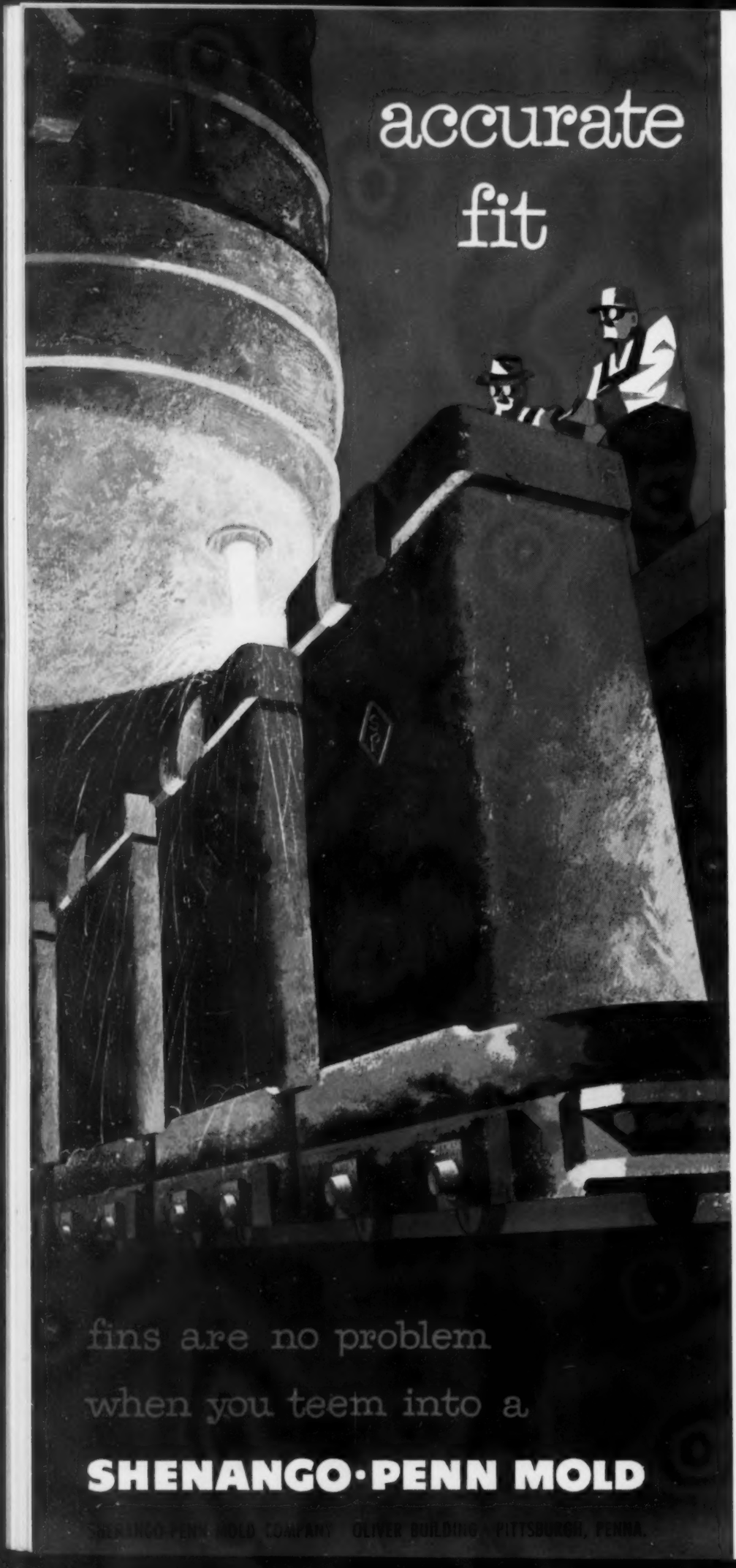

and adding special construction features. The cars are also equipped with steam holes in the sides so that frozen materials may be defrosted quickly and efficiently. This will expedite the handling of heavy commodities during the winter months. The car manufacturing company hopes to deliver the first of these new cars to the Bessemer and Lake Erie in April of 1952.

LONE STAR COMPLETES PLANT FOUNDATION WORK

▲ The job of driving more than 68 miles of piling, upon which will rest Lone Star Steel Co.'s new $75,000,000 steel mill, was completed October 6 at the East Texas works north of Longview. In all, almost 7000 pilings were driven, some of them to a depth of as much as 60 ft.

As workmen began the job of removing pile-driving equipment from the site, other crews continued the brisk construction pace which has characterized the job begun last Easter Sunday. The excellent construction weather of the past summer had enabled the job to maintain a schedule which promises steel and steel pipe before the end of 1952.

Lone Star's progress report indicates the stockyards are about one-third completed. The high line is nearing the 50 per cent mark, and the slag pits are about 40 per cent finished. In the open hearth building proper, concrete work for the furnace foundations, flues and stacks is in progress. The refractory material was on hand when contractors began installation of this material toward the end of September. Railroad connections to the open hearth are complete.

Work on the steel pipe division of the program is lagging behind the schedule set for construction of the open hearth furnaces and other steelmaking facilities. Lone Star officials said the program had been planned in this manner so that the metal manufacturing side of the operation would have ample time in which to "break in" the new plant before the pipe mill is ready for production. The latter installation will manufacture 350,000 tons of oil country tubular goods in all commercial grades and sizes. This output is expected to be a boon to southwestern oil companies whose activities are threatened because of pipe shortages.

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FREE SURVEY: Place your rust problems in the hands of a RUST-OLEUM specialist. He will survey your plant for all rust problems, submit detailed recommendations, and make specific tests.

You can stop rust with RUST-OLEUM! An exclusive formula proved in a wide range of industrial and marine applications for more than 25 years. Its tough, pliable film dries to a firm rust-resisting coating that protects against rust—cuts maintenance costs—adds years of use to many metal surfaces, indoors and outdoors.

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HARBISON ACQUIRES CALIFORNIA PLANT

▲ Harbison-Walker Refractories Co. through a wholly owned subsidiary is about to acquire the Warm Springs, Calif. plant of Laclede Christy Co. This permits the company to enter immediately into a wider field in the production of basic refractories, and later of silica refractories. Up to this time the Warm Springs plant has been devoted to the manufacture of tank blocks and other specialties for the glass industry.

Harbison-Walker has organized a wholly owned Brazilian subsidiary, named Harbison-Walker Minerios Ltda. which has acquired exclusive mining rights to large deposits of exceptionally pure magnesite in Brazil. The company has had these deposits under consideration for a considerable period of time and has based its decision to acquire them on the results of geological studies and exploratory work. Important additions have thus been made to the reserves of crude magnesite held by the company.

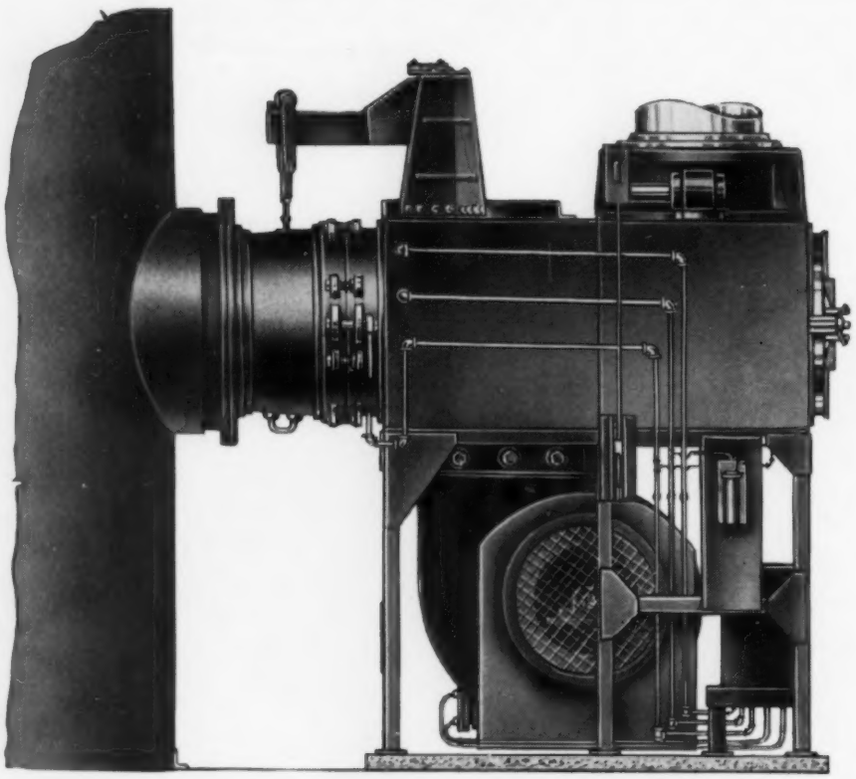
LOFTUS ANNOUNCES TWO NEW CONTRACTS

▲ Loftus Engineering Corp. has been awarded contract for 10 two-pit batteries of two-way top fired recuperating soaking pits for United States Steel Co. at the new Fairless works, Morrisville, Pa.

Loftus also has been awarded a contract for four 250 ton open hearths at the Portsmouth, Ohio, plant of the Detroit Steel Corp. This will double the production which will bring it well over a million tons.

Ideal Combustion Conditions for

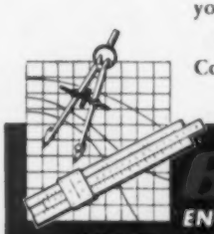
MAXIMUM STOVE CAPACITY!



the **BLOOM-PAULSEN-STEINBART**

BLAST FURNACE STOVE BURNER

Automatic proportioning of air and gas at the ratio you select provides combustion conditions that assure correct temperature distribution for maximum stove heating capacity. Compact, sturdy construction; easy to operate and flexible.



BLOOM ENGINEERING CO., INC.
837 W. North Avenue Pittsburgh 33, Pa.

Write for illustrated bulletin giving full details and operating data.

ALGOMA STEEL BUYS HEATING FACILITIES

▲ A new billet heating furnace and three complete batteries of soaking pits will be built for the Algoma Steel Corp., Ltd., at Sault Ste. Marie, Ontario, according to the Rust Furnace Co.

The furnace, a double-fired, side charged and discharged type, will have a capacity of 80 tons per hour. To serve a new combination bar and strip mill, it is designed to heat billets from 2½ to 4 in. square, and slabs 2½ to 4½ in. in thickness, accommodating both slabs and billets in lengths up to 30 ft. It will be fired with either coke oven gas or fuel oil.

The three new batteries of three-hole soaking pits are of the modern regenerative type. As an addition to three existing batteries of Rust pits, they will serve a blooming mill, permitting an increase in its rolling capacity. They are designed for use with a lean mixture of coke oven and blast furnace gas of approximately 130 Btu.

Both the new furnace and the soaking pits will be equipped for full automatic control of temperature, pressure, and fuel-air ratio.

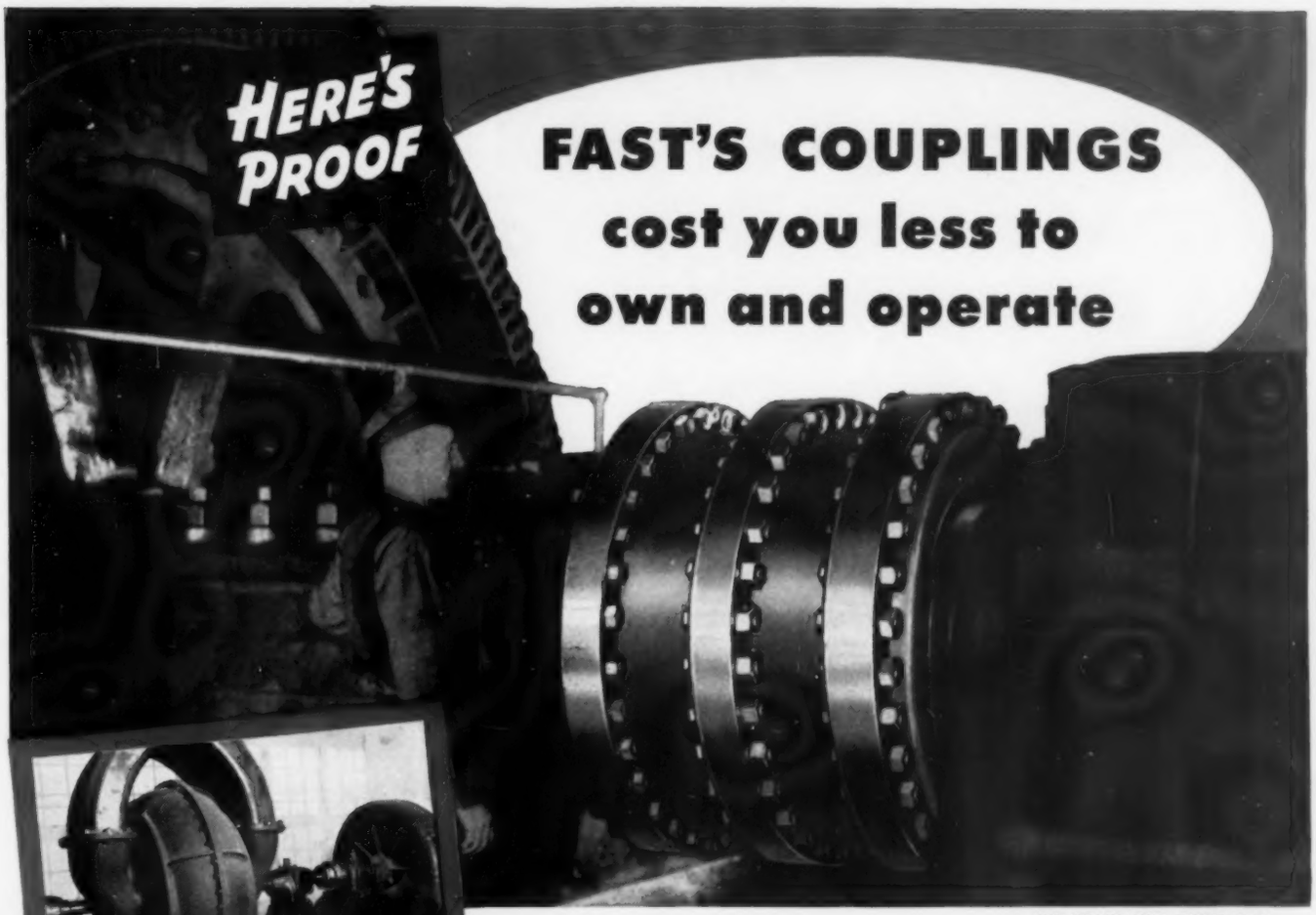
CLEVELAND BLAST FURNACE ESTABLISHES NEW RECORD

▲ Cleveland No. 5 blast furnace of Republic Steel Corp. established a new corporation blast furnace production record during the month of September W. M. Kelley, vice president in charge of operations announced recently.

The Cleveland furnace produced 48,005 tons during the thirty-day month Mr. Kelley said. This is at the

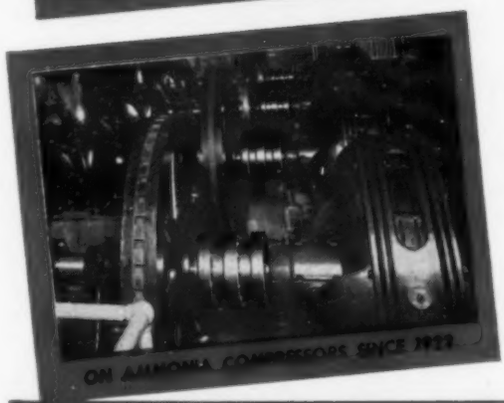
HERE'S PROOF

FAST'S COUPLINGS cost you less to own and operate



ON BILLET MILL SINCE 1923

ON GAS BLOWER SINCE 1929



ON AMMONIA COMPRESSORS SINCE 1922

Fast's Couplings cost you less per year because they normally outlast the equipment they connect. That means their reasonable cost can be spread out over 20 years or more . . . assuring low-cost service without excessive maintenance costs!

Fast's basic design is *foolproof!* Instead of a perishable oil seal, Fast's are the only couplings to use a *permanent* metal-to-metal closure. Oil is always maintained at a safe level . . . whether the coupling is running or standing still . . . and dirt cannot get in. Fast's Couplings are compact, yet large enough to stand up under punishing service for 20 years or more!

When you specify Fast's Couplings, you get Koppers' valuable engineering service. In many cases where a special coupling appears necessary, Koppers engineers can modify a standard Fast's and save you money! Get the facts on Fast's Couplings. Mail the coupon for your copy of Fast's *free* Catalog today!

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City.....Zone.....State.....

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Couplings

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Efficient Pickling with . . .

Rodine®

PICKLING ACID INHIBITORS

SAVES ACID
SAVES STEEL
SAVES MONEY

Use RODINE in sulfuric and muriatic acid baths for improved pickling and increased production.

In straight line pickling of wire, rod and tubing, RODINE makes available more metal for drawing by protecting steel from acid attack. In batch pickling of sheet steel, RODINE improves the surface. In rapid, continuous strip pickling, RODINE not only saves acid and metal, but also prevents over-pickling during line shutdowns.

Now, more than ever, it is cheaper to pickle with RODINE than without it.

"RODINE" meets Government Specification No. U.S.N. 51-I-2.

STANDARD RUST PROOFING PRACTICE THE WORLD AROUND
CHEMICALS ACP PROCESSES

AMERICAN CHEMICAL PAINT COMPANY

AMBLER, PENNA.

Write for descriptive folder on RODINE Pickling Acid Inhibitors.

rate of 1600 tons per day or 1.1 tons per minute. The expected capacity of the furnace at the time of its construction in 1943 was 1250 tons.

The furnace is operated by the revolutionary high top pressure technique developed by Republic in conjunction with Arthur D. Little, Inc. of Cambridge, Mass. This process permits greater than normal volumes of air to be blown into the furnace without uneconomical loss of raw materials which otherwise would be blown out the furnace top into the dust recovery system.

Republic recently installed the world's largest blast furnace blowing turbine at the No. 5 furnace. This turbine permits up to 125,000 cfm of air to be blown into the furnace at pressures up to 40 psi.

Mr. Kelley said that an air volume of 120,000 cfm had been used on the furnace during September. A conventionally operated furnace cannot exceed 90,000 cfm without heavy loss of raw materials.

Since production of a blast furnace is directly proportional to the volume of air blown into it, the new turbo blower has made such record production possible Mr. Kelley said. He added that the furnace had been operated the entire month on a conventional burden of average Lake Superior iron ore blended with a small percentage of iron ore concentrate from Republic's Adirondack mines. The burden averaged 51.9 per cent iron.

The No. 5 furnace was built by Republic for the federal government during World War II. Hearth diameter at the time of construction was 27 ft. Late last year the furnace was rebuilt and the hearth increased to 28 ft. Republic acquired the furnace last November.

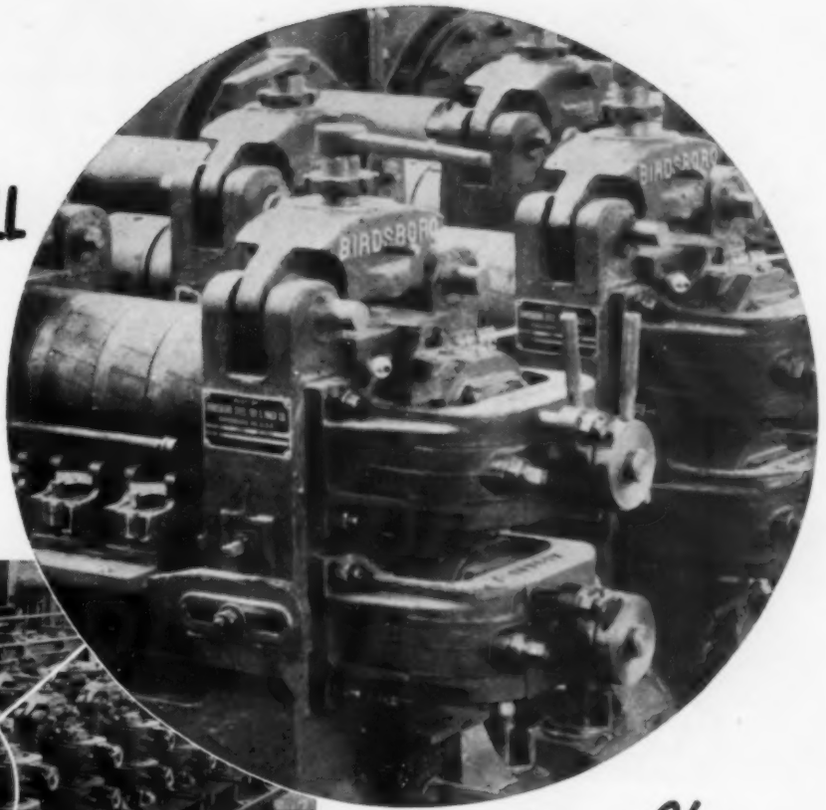
A duplicate of the Cleveland No. 5 furnace is under construction on the same property and is expected to go into production in January.

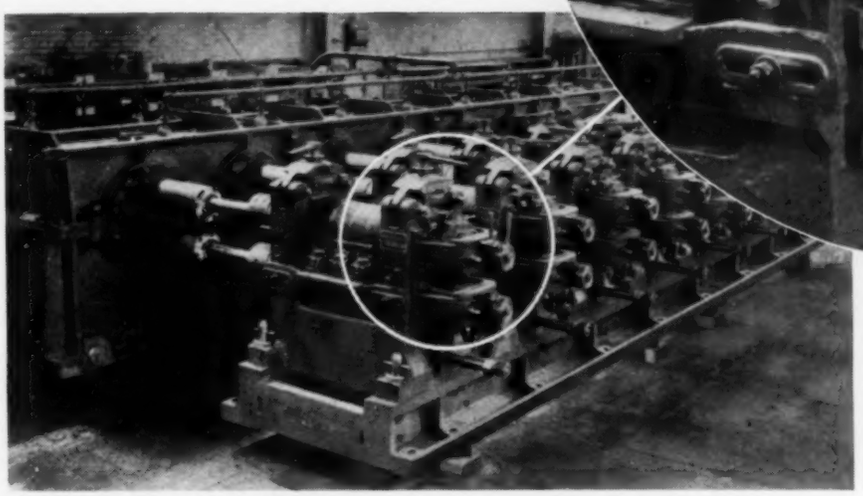
DRAVO DESIGNS NEW LIGHTWEIGHT TROLLEY

▲ A new lightweight man trolley is being designed and fabricated by Dravo Corp. for an existing ore handling bridge at Granite City Steel Co.'s plant, Granite City, Ill.

The new trolley will operate with a 12-ton bucket and will replace the original trolley which was designed to

NEW ROLLER-BEARING END ROLL *Reduces Downtime*





Steps Up Production

**End roll adjustment patent applied for.*

● The greatest improvement in end roll mechanism made in years . . . permits more accurate and faster end roll adjustment; more flexible operation and minimum maintenance.

The roller bearing is locked to the end of the roll, but may be changed in a jiffy—need not be removed for dressing or until the roll is scrapped. When rolls need changing, patented tilting caps swing up and rolls are raised through top of housing without disassembling end roll adjustment.*

Heavy C clamps secure the bearing housing to the frame with self-aligning surface contact for easy vertical adjustment without wear of clamping surface.

This advanced design typifies the Skill and experience of Birdsboro engineers. We'll be glad to apply our engineering service to your mill machinery problems anytime you say the word.

MM-20-51

STEEL MILL MACHINERY

BIRDSBORO
STEEL FOUNDRY & MACHINE CO.
Birdsboro, Penna.

Designers and Builders of:
Steel Mill Machinery • Crushing Machinery • Rolls
Hydraulic Presses • Special Machinery • Steel Castings

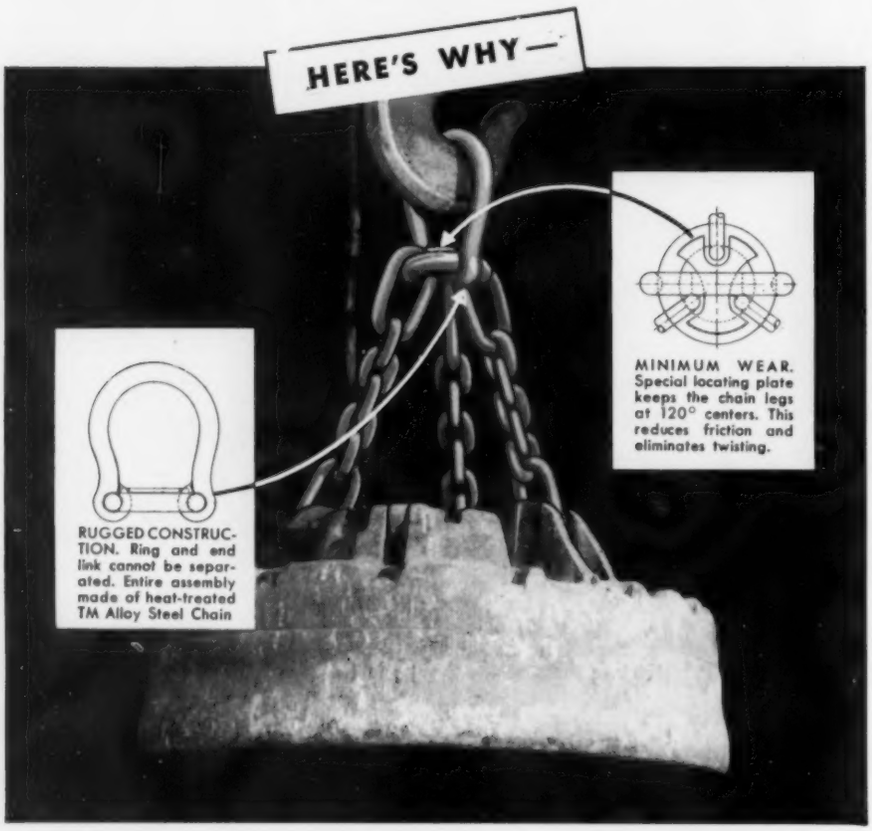
Offices in:
BIRDSBORO, PA.
and
PITTSBURGH, PA.

TM Alloy Steel Downtown

Frictionless
MAGNET CHAINS

DO MORE WORK, LAST LONGER,

COST LESS than conventional types!


HERE'S WHY—
MINIMUM WEAR. Special locating plate keeps the chain legs at 120° centers. This reduces friction and eliminates twisting.
RUGGED CONSTRUCTION. Ring and end link cannot be separated. Entire assembly made of heat-treated TM Alloy Steel Chain

Extensive on-the-job tests prove TM Alloy Steel Downtown Magnet Chains superior to any other three-leg assemblies on the market. Patented design of end link and horizontal ring with special locating plate keep chain legs at 120° centers. This prevents ganging-up, excessive friction and twisting . . . assures level lifts and even distribution of load weights. Additional long life, safety and economy is assured by Heat-Treated TM Alloy Steel Construction. High tensile strength, great resistance to abrasion, grain growth and shock at sub-zero temperatures are only a few of the TM Alloy Steel qualities. Send coupon today for details!

S. G. TAYLOR CHAIN COMPANY, Hammond, Indiana

S. G. TAYLOR CHAIN COMPANY
Dept. 5 Hammond, Indiana
Rush literature and prices on TM Alloy Steel Downtown Magnet Chains.

NAME _____

ADDRESS _____

TAYLOR MADE
A GREAT NAME IN
Chain SINCE 1873

handle a 7½-ton bucket. Two new 600-series mill-type direct current motors will power the trolley and two others will be used for bucket hoisting, holding and closing drums.

The lightweight trolley will be assembled and tested at Dravo's plant before shipment to Granite City.

CONTINENTAL FOUNDRY TO USE BETATRONS

▲ Continental Foundry and Machine Co. recently placed in continuous operation an Allis-Chalmers motorized industrial betatron for production line inspection of heavy ordnance equipment at its East Chicago, Ind. plant.

Located in the same area originally occupied by a one-million-volt x-ray machine which was too slow for production inspection of large pieces, the new 20-million-volt betatron has greater flexibility and five times the penetrating power of the old machine.

The betatron is capable of detecting flaws as small as 0.02 in. in castings, forgings and weldments from 1 to 24 in. thick. It is so flexible that it can examine areas from 6 in. long to sections over 20 ft in length with no sacrifice in detection ability.

The betatron has an unique mounting which leaves the floor entirely clear for moving and checking large pieces without interference, and thus permits accurate positioning for still radiography. Complete motorization also allows for a smooth sweep to cover a wide band with a continuous motion. Mounted on a 30-ft high bridge crane, the betatron provides a wide range of speed for each of the five motions.

Continental Foundry is installing a second betatron at its Coraopolis, Pa., plant.

SKF BUYS PLANT IN ALTOONA, PA.

▲ SKF Industries, Inc., has purchased the plant occupied by the Blair Shirt Co., in Altoona, Pa.

The plant is a one-story modern brick, steel and concrete structure, and is only two years old. It contains approximately 49,000 sq ft of floor space. There is approximately 6 acres of ground adjoining the plant which provides ample parking space and room for future expansion.

The bearing firm now operates

...TO GIVE YOU A CONTROL CABLE THAT AVERAGES* 46% SMALLER IN AREA

By teaming Polyethylene with Nylon on conductors — sheathing the cable with Rockhide — Rockbestos has developed a radically new and better control cable. It has high dielectric strength *plus* all the advantages of smaller size. As a result, you can put a 12 conductor cable in a conduit now carrying 6 or 7, or use smaller size conduit to save conduit fitting and installation costs. — Save steel.

It will pay you to get the PNR story. Write or ask your nearest Rockbestos representative.

*Average determined by comparison with competitive control cable.

QUICK FACTS ON NEW ROCKBESTOS PNR CONTROL CABLE

46% smaller area* ... 28% smaller diameter*. Use smaller conduit and fittings or put more conductors in present conduit.

Dielectric breakdown ... over 40 times operating voltage.

Versatile ... bury it in the ground! Hang it on a pole! Use it in a conduit!

Lighter and smaller. Easier to handle, store, ship, pull through conduit.

Stands weather ... sunlight, chemicals, oil, gasoline, grease.

Flexible to —25°C (—13°F). No cracking!

Rated 600 volts ... conductor operating temperature 75°C (168°F).

ROCKBESTOS PNR

... another different, better cable by

ROCKBESTOS PRODUCTS CORPORATION, NEW HAVEN 4, CONN.

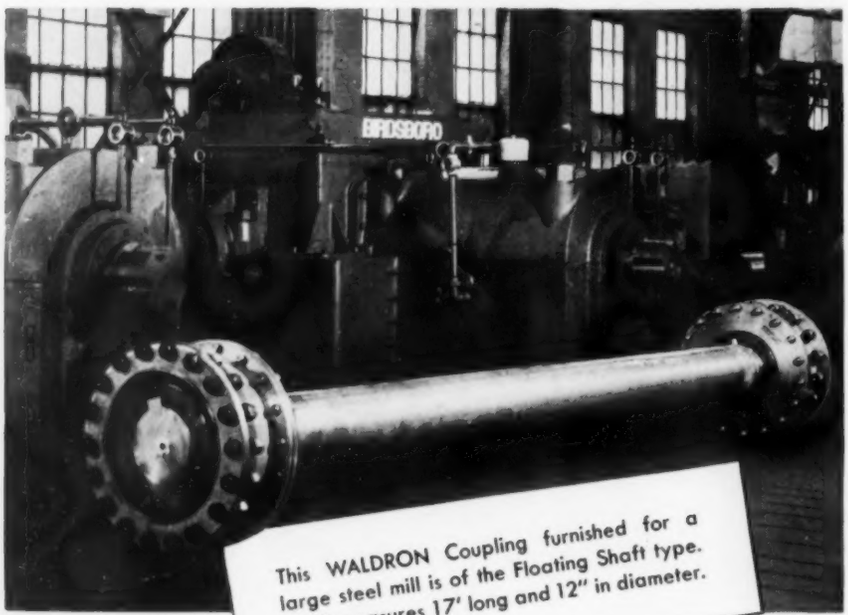
the originators of A. V. C.®

New York Pittsburgh | Cleveland St. Louis | Detroit Los Angeles | Chicago Oakland, California

For The RUGGED Jobs...

WALDRON Improved Gear Type COUPLINGS

get the nod!



This WALDRON Coupling furnished for a large steel mill is of the Floating Shaft type. Shaft measures 17' long and 12" in diameter.

they are built for dependable service

...AND THEY GIVE IT!

Large or small—every WALDRON Coupling is designed and built with typical operating troubles in mind. Forty years of experience has taught WALDRON engineers the pitfalls to be avoided in producing a dependable coupling. The WALDRON design eliminates the usual sources of trouble; the WALDRON construction is simple and strong—forged steel parts, no welded sections, better lubrication.

The steadily growing preference for these sturdy WALDRON couplings in all major industries is a tribute to the quality and workmanship that goes into them.

Write for this Helpful Folder

explaining coupling features which give added insurance against coupling failure. No obligation.

JOHN WALDRON
CORPORATION
New Brunswick, New Jersey
Authorized Sales Representatives in Principal Cities

three plants in the Philadelphia area, one plant at Shippensburg, and another at Hornell, N. Y.

GRANITE CITY EXPANSION IS WELL UNDERWAY

▲ Work is well underway on the new multi-million dollar expansion program of Granite City Steel Co. at Granite City, Ill., according to Rust Engineering Co.

The program, to increase production of flat rolled products at the company's Granite City hot strip mill, includes construction of three new open hearth furnaces, a blooming mill, three new slab heating furnaces, and alterations to the present strip mill, plus miscellaneous work.

In the design and erection of the three new slab heaters, the Rust firm will operate in conjunction with its subsidiary, the Rust Furnace Co. The latter having completed in 1949 the latest of the four open hearth furnaces now operating.

The new continuous slab heaters will be of the most modern Rust zone-controlled, triple-fired, recuperative type. Each will have an estimated capacity of some 100 tons per hour and will be equipped for firing with natural gas, or fuel oil, with full automatic control of combustion, temperature and furnace pressure.

The Rust contract also includes all piping and electrical work, all foundation and building construction, plus erection and installation of all mill machinery.

Modernization of the hot strip mill now underway involves alterations and additions to the existing mill stands and the revamping of mill tables and equipment up to the existing finishing stands.

MACKINTOSH ENTERS NEW MANUFACTURING FIELD

▲ Mackintosh-Hemphill Co., has entered a new field of steel manufacture and is currently producing a line of forged steel rock bits which are being distributed by a newly-organized subsidiary company to the mining, quarry, construction and other heavy industries.

Col. James S. Ervin, president of Mackintosh-Hemphill, announced the formation of the company's Drill Bit and Tool Division. This new division is charged with the research, develop-

THESE ARE SOME OF THE THINGS A WELL-RUN EXPOSITION IN *YOUR* FIELD DOES FOR YOU:

- Brings your prospects to you
- Enables you to actually demonstrate your products
- Renews customer contact
- Introduces new products quickly
- Establishes contact with people your salesmen can't reach
- Produces inquiries and leads
- Opens new markets for you
- Builds sales organization confidence
- Establishes your firm
- Enables you to broaden your sales organization

NOTHING TO SELL ?

One of the most trying times any company can go through is when it is "sold out".

With nothing to sell, contacts with customers and prospects inevitably lag, morale of the sales organization weakens, worries mount as to what you will do "when the rush is over".

There is a simple answer to all this—the exposition which covers your and your customers' trade or industry—the one time and place where your customers and prospects will come to see YOU.

By exhibiting, you renew and maintain your customer contacts, you can discuss 'future business', you maintain and rebuild morale in your sales organization, you keep your company and your products 'sold'.

The one time you should *not* fail to exhibit is when you have "nothing to sell".

This advertisement which was prepared by the National Association of Exhibit Managers, is sponsored by the

IRON AND STEEL EXPOSITION

(Held in conjunction with the Annual Convention of the Association of Iron and Steel Engineers)

September 30 through October 3, 1952

CLEVELAND PUBLIC AUDITORIUM
CLEVELAND, OHIO

ment and manufacture of a line of disposable rock bits. These bits are being manufactured in a new building adjacent to the company's Midland plant at Midland, Pa.

SHEFFIELD STEEL BUYS COKE OVEN BATTERIES

▲ Sheffield Steel Corp., Houston, Tex., has awarded the engineering and construction division of Koppers Co., Inc., a contract to design and construct a battery of 15 new chemical-recovery coke ovens at its Houston plant.

The new battery will be of the latest Koppers-Becker underjet design, and the contract also provides for the erection of certain auxiliary equipment. Sheffield's Houston plant now has 47 chemical-recovery coke ovens and the new battery will increase the plant's annual coal carbonizing capacity to more than 500,000 tons.

Engineering work on the new Koppers battery will start at once with construction work following as soon as possible.

NPA REVEALS DATA ON MANY STEEL USES

▲ The National Production Authority has revealed interesting data concerning many miscellaneous uses of steel, not previously detailed in the steel industry's statistics of distribution, American Iron and Steel Institute said recently.

The NPA figures appear in a list of approximately 100 allotments of steel to so-called defense supporting consumers for the fourth quarter of this year under the Controlled Materials Plan.

The fourth quarter allotment for buttons is 718 tons, mops and dusters, 1379 tons; brooms and brushes, 1135 tons; drapery hardware, 3625 tons; venetian blinds, 35,500 tons.

The list goes on: squeegees, 18 tons; carpet sweepers, 691 tons; fireplace equipment, 1740 tons; sporting equipment, 16,997 tons; baby carriages, 5100 tons; games, toys, dolls, 35,400 tons; musical equipment, 1602 tons; picture frames, 600 tons; signs, 18,700 tons, umbrella frames and canes, 4500 tons.

In the three months household refrigerators and freezers will receive about 141,333 tons; various types of home and office furniture, 162,192 tons; domestic stoves and ranges, 80,515 tons; household washing machines, 38,175 tons.

LEADERS TRY TO UNSNARL STEEL SUPPLY SITUATION

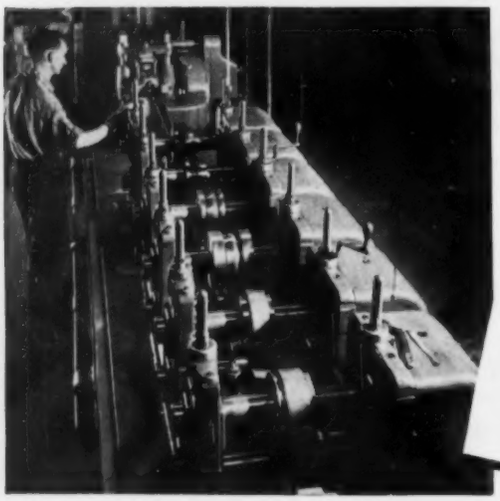
▲ Steelmen are hopeful that an "understanding" attitude of the government's defense production authorities will unsnarl the steel supply situation, Edward L. Ryerson, chairman of Inland Steel Co., said recently.

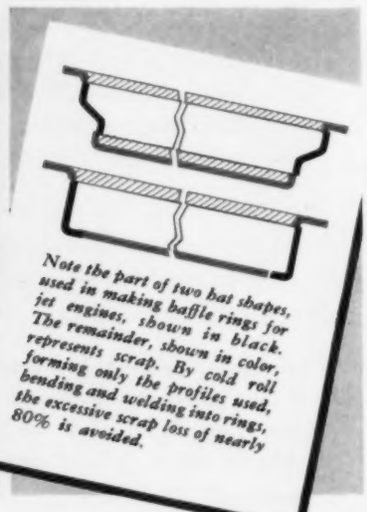
Mr. Ryerson, with other steel leaders, presented recommendations for changes in the controlled material plan for steel to Charles E. Wilson, director of the Office of Defense Mobilization, and Manly Fleischman, administrator, Defense Production Authority.

"We realize the Defense Production and the National Production Authority are trying to make CMP work," Ryerson said. "Men in the steel industry feel that no control of production and distribution is needed in view of the fact that defense is taking less than 15 per cent of the steel made.

"However," he added, "industry representatives accept the fact that the government intends to continue steel controls with the understanding that they be eliminated as soon as practicable. Accordingly we have submitted our suggestions as to

12 EXAMPLES OF ECONOMIES
effected by combining different operations in a YODER Roll Forming Machine




Note the part of two hat shapes, used in making baffle rings for jet engines, shown in black. The remainder, shown in color, represents scrap. By cold roll forming only the profiles used, bending and welding into rings, the excessive scrap loss of nearly 80% is avoided.

No. 12. Up to 80% saving in material cost by cold-roll forming, avoiding former heavy scrap loss

Of all the methods available for cold-shaping flat rolled metal, the cold roll forming machine offers the highest production per man hour and the lowest conversion cost. It is often a good investment even when operated only a few days per month.

Of still greater importance than conversion cost is often the saving of weight which may be effected by designing light, strong box, tubular and other special structurals to take the place of hot rolled angles, channels, trees, etc. Material savings up to 50% are frequently made.

In press forming of hat shapes to make stator rings for jet engines, up to 80% of the metal has to be cut away and discarded in order to obtain one ring. By cold roll forming the profile from strip, cutting to length, bending into rings and joining ends by welding, this huge scrap loss is avoided. Here is another example of how a Yoder cold Roll Forming production line may save scarce and expensive stainless steel, aluminum, brass and other metals. In such cases, the material savings alone may be many times greater than the conversion cost, even for relatively small quantities.

Function, scope, and economics as well as mechanics of cold roll forming, are discussed in Yoder's 86-page illustrated book which will be sent on request. Recommendations and estimates for the asking.

THE YODER COMPANY • 5495 Walworth Ave., Cleveland 2, Ohio

Complete Production Lines
★ COLD-ROLL-FORMING and auxiliary machinery
★ GANG SLITTING LINES for Coils and Sheets
★ PIPE and TUBE MILLS—cold forming and welding

ENGINEERING YODER MANUFACTURING

Giant with facile jaws

When the sturdy Brosius Auto Floor Forging Manipulator takes a billet or blank in its teeth, it improves upon every action possible with chain hoist and porter bar or cumbersome overhead equipment. More swiftly and easily it draws or charges . . . moves more quickly and independently across the forging floor . . . manipulates at hammer or press with more sensitive movements. Moreover, this remarkable modern mammoth brings to your forge shop added production, added safety, added economy — you should be using one. Write us.

BROSIUS DIVISION

Salem-Brosius, Inc., Pittsburgh 15, Pa.

Affiliates: Salem Engineering Division,
Salem Engineering Co., Ltd., Milford nr. Derby, England; Salem Engineering (Canada) Ltd., Toronto, Canada

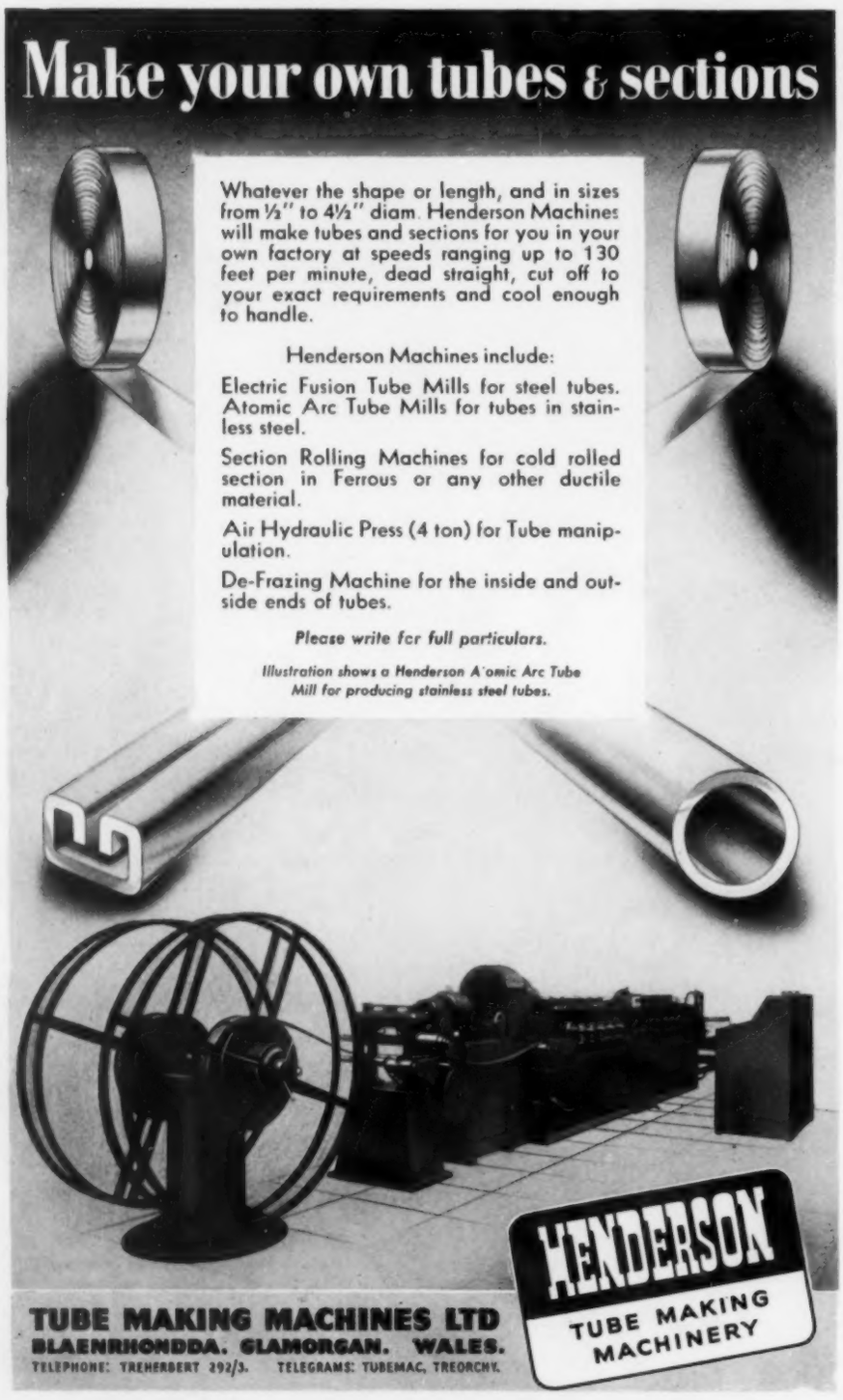
changes that will make CMP more workable."

The steelmen urged that government production authorities "audit" steel need requests from consuming industries. They said that requests for the final quarter of 1951 were almost twice the tonnage used quarterly in 1950 and termed the demand "totally unrealistic."

The report to Wilson and Fleischman was made by a group selected to represent the entire industry. It included Benjamin F. Fairless, president, United States Steel Corp.; Eugene G. Grace, chairman, Bethlehem Steel Corp.; John N. Marshall, chairman, Granite City Steel Co.; William H. Colvin, Jr., president, Crucible Steel Co. of America; and Ryerson.

Wilson told the steelmen that their recommendations would be carefully considered, Ryerson said. "Mr. Wilson said that he considered our report helpful," the Chicago steel executive said. "Some suggestions were in line with steps already being taken by NPA, according to Mr. Wilson, who said the others would be studied with a view of putting them into effect."

Ryerson said that the steelmen left the meeting with the feeling there was complete understanding on the problems involved and that the industry and government were making a joint effort to make the controls work.


Make your own tubes & sections
Whatever the shape or length, and in sizes from ½" to 4½" diam. Henderson Machines will make tubes and sections for you in your own factory at speeds ranging up to 130 feet per minute, dead straight, cut off to your exact requirements and cool enough to handle.
Henderson Machines include:
Electric Fusion Tube Mills for steel tubes. Atomic Arc Tube Mills for tubes in stainless steel.
Section Rolling Machines for cold rolled section in Ferrous or any other ductile material.
Air Hydraulic Press (4 ton) for Tube manipulation.
De-Frazing Machine for the inside and outside ends of tubes.
Please write for full particulars.
Illustration shows a Henderson Atomic Arc Tube Mill for producing stainless steel tubes.
TUBE MAKING MACHINES LTD
BLAENRHONDDA. GLAMORGAN. WALES.
TELEPHONE: TREHERBERT 292/3. TELEGRAMS: TUBEMAC, TREORCHY.
HENDERSON
TUBE MAKING MACHINERY

SHELL BUILDING NEW SULPHUR RECOVERY UNIT

▲ In a move aimed at alleviating the critical shortage of sulphur and its most important compound, sulphuric acid, Shell Chemical Corp. will add to its Houston, Tex., operations a unit for recovering sulphur from waste refinery gases. Output of the new unit will be sold for conversion to sulphuric acid.

Sulphuric acid, or oil of vitriol, is so fundamental a chemical with so many varied commercial uses (chemicals, oil, steel, paper, fertilizers, paints, to cite a few), that its total consumption provides a pertinent index of the industrial activity of any nation.

The new sulphur recovery unit, certified by the government as a necessary defense project is expected to be in operation by mid-1952. In the recovery process, waste refinery gases, containing hydrogen sulphide, carbon dioxide and a small percentage of light hydrocarbons, will be burned and catalytically converted to sulphur at an annual rate in excess of 13,000 tons.

Sulphur recovery is not generally a part of petroleum refining operations. With annual U. S. sulphur consumption leading domestic production by some 500,000 tons, the Shell Chemical installation is of note not only because of its conservation of a strategic raw material, but also because it will help to eliminate the problem of atmospheric pollution in the heavily industrialized Houston area.

MOHR INCORPORATES OPEN HEARTH FIRM

▲ John Mohr & Sons, Chicago, Ill., has announced the incorporation of a subsidiary company, the Mohr Open Hearth Division, Inc., which has been formed to engage in all phases of open hearth engineering and construction.

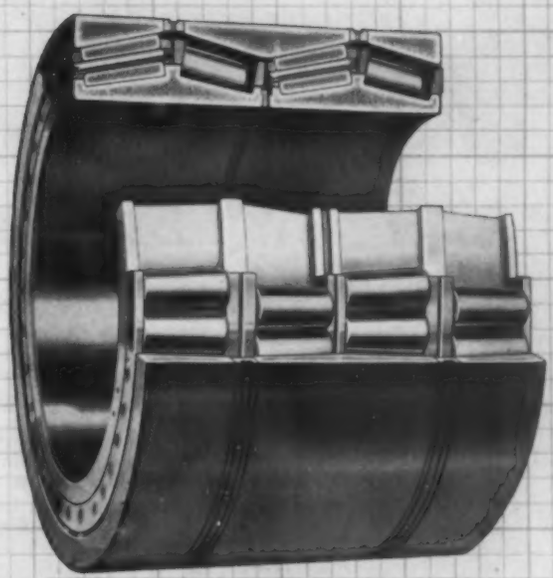
The primary interest of the Mohr Open Hearth Division, Inc., is the design, engineering and construction of open hearth furnaces. In addition

meeting all demands . . .

Torrington Roll Neck Bearings are engineered to sustain maximum production under heavier screw-down pressures and greater speeds.

Four rows of closely-spaced tapered rollers provide tremendous radial and thrust load capacity. Reduced bearing cross-section permits larger roll neck diameters. Low coefficient of friction allows faster acceleration and operation. These advantages all contribute to the production of more and more better quality steel.

Our engineers will welcome the opportunity of working on your friction problems—for rolling mills or other heavy-duty equipment.



THE TORRINGTON COMPANY

South Bend 21, Ind. • Torrington, Conn.

District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON *TAPERED ROLLER* **BEARINGS**

SPHERICAL ROLLER • TAPERED ROLLER • STRAIGHT ROLLER • NEEDLE • BALL • NEEDLE ROLLERS

to general work in this field, agreements have been made with Maerz Industrie—Ofenbau A.G. of Zurich, Switzerland, by which the new company is licensed to offer the patented Maerz designs for open hearth furnaces to the American steel industry.

Major increases—from 10 to 30 per cent—in both furnace capacity and rate of production can be obtained from the Maerz design in almost all American open hearth furnaces at relatively small commission cost. Preliminary presentation of these ideas to American steel plant operators has already gained widespread interest.

In organizing the Mohr Open Hearth Division, Inc., it was necessary to acquire personnel familiar with open hearth design and construction. Officers of the new company are: Albert Mohr, Jr., president, Mervin A. Fay, vice president; Louis E. Mohr, vice president, and Robert E. Marsh, secretary-treasurer.

Mr. Fay was selected as vice president in charge of operations because of his extensive background in the field. He is well known throughout the steel industry as author of numerous technical articles on refractories, furnace construction and furnace design. He has travelled widely, visiting steel producing plants in America, South America and Europe, and has observed the operation of many Maerz Design open hearth furnaces.

Mr. Fay was formerly assistant general sales manager of the General Refractories Co. and prior to that was associated with the research department of the same company. In these positions he was instrumental in bringing about the rapid development of basic ends and all basic roofs for open hearth furnaces in this country. Prior to his association with the General Refractories Co., he was employed for nine years by the Bethlehem Steel Co. in the research and development department and as ceramic engineer in the Sparrows Point, Md., plant.

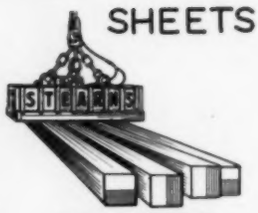
SAVE TIME SAVE LABOR

SCRAP

PIG IRON

ROUNDS

SHEETS



BILLETS

"Small Bite—Big Load"

LIFTING and transporting these two huge steel castings (each weighing 4000 pounds), is everyday work for this STEARNS Lifting Magnet at the Maynard Electric Steel Casting Co., Milwaukee. This 45" diameter circular magnet is one of a team of STEARNS Lifting Magnets used throughout the cleaning room and foundry whenever castings have to be moved — doing the job efficiently and economically year in and year out.

If you handle castings, borings, turnings, pig iron, strip steel, rails, slabs, billets or scrap iron, there's a STEARNS Lifting Magnet EXPERIENCE ENGINEERED to help you save time and money. For the efficient handling of flat steel sheets, plates and bars, be sure to investigate STEARNS Rectangular Lifting Magnets.

STEARNS Lifting Magnets are available in standard sizes in both bolted and all welded constructions. Special sizes and shapes made to meet your requirements.

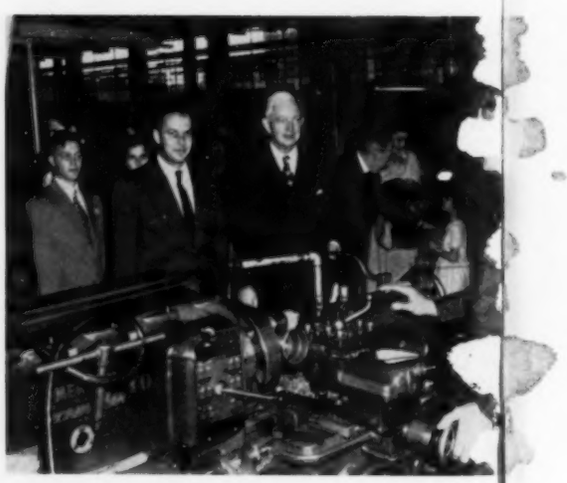
Write today for complete specifications and operating data.

Foremost in the Magnetic Field

Stearns MAGNETIC INC.

681 S. 28th St., Milwaukee 46, Wisconsin

OPEN HOUSE AT FOOTE



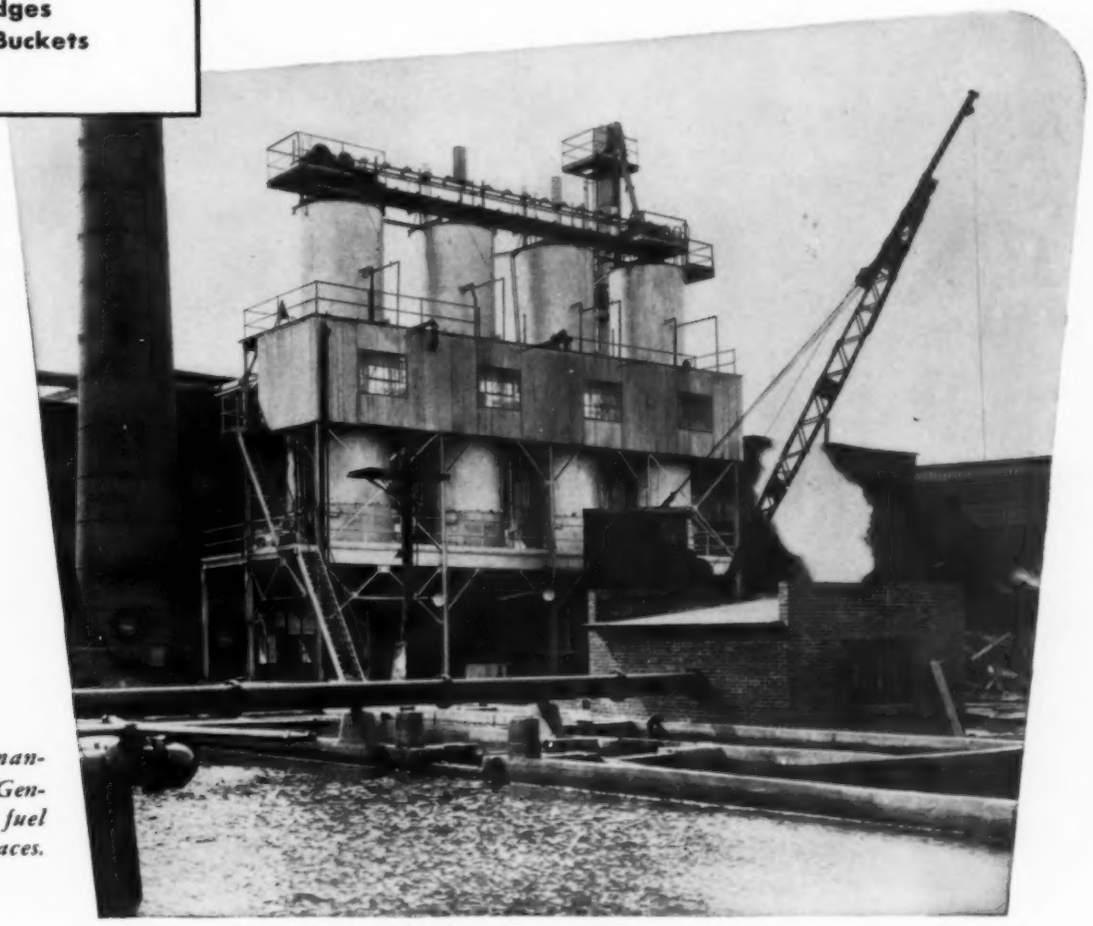
Recently Foote Bros. Gear and Machine Corp. held an "open house" for their employees and their employees' families. The three plants, located at 4545 South Western Boulevard, Chicago, 53rd Street and Western Boulevard, Chicago, and in Downers Grove, were open from 11:00 a.m. to 5:00 p.m. on September 30. Over 6000 persons attended the open house and were given a complete explanation of the manufacture of the precision gears, aircraft mechanisms, speed reducers, gearmotors, and commercial gears which the company produces. Chartered buses took the guests to the various plants, and a buffet lunch was served under a tent at the 53rd Street plant.

Wellman will build it

Special Cranes
Gas Producer Plants
Charging Machines
Industrial Furnaces
Car Dumpers
Gas Flue Systems
Gas Reversing Valves
Coke Pushers
Mine Hoists
Skip Hoists
Ore Bridges
Clamshell Buckets

Wellman-Galusha Clean Gas Generators

Built exclusively by Wellman



Four 10 ft. Wellman-Galusha Clean Gas Generators supplying fuel for steel mill furnaces.

• Only Wellman builds the Galusha Clean Gas Generators that so ideally meet your requirements with efficiency and economy. These generators combine, in a *complete* machine, the rotary grates, ample fuel storage bin, and provisions for generating the steam required for making the gas. Even the lowest-priced grades of Anthracite and coke can be satisfactorily gasified.

THE WELLMAN ENGINEERING COMPANY

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a Wilputte Battery -

battery 15-77 ovens

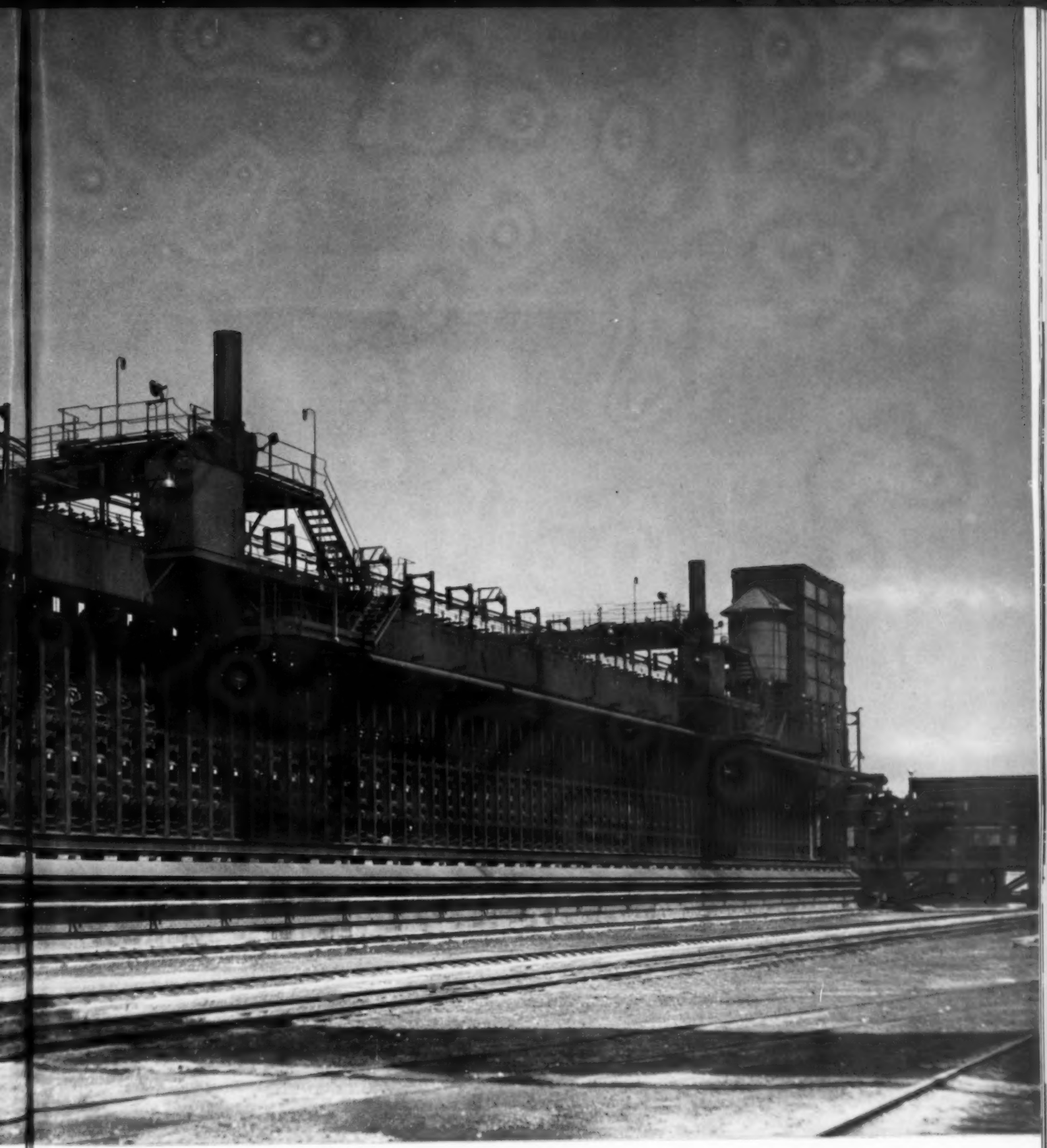
placed in operation at the

United States Steel Company

Gary Works

during 1951

WILPUTTE



COKE OVEN DIVISION

ALLIED CHEMICAL & DYE CORPORATION

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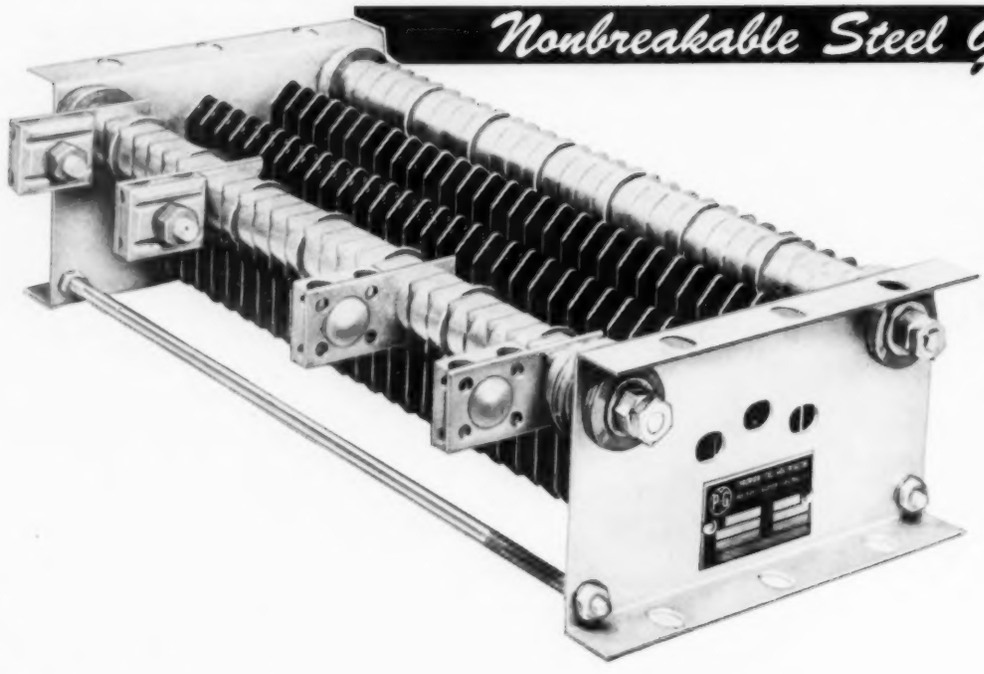
IS IMPORTANT TRY . . . POST-GLOVER

Nonbreakable Steel Grid Resistor



- All Steel Construction
- Mica Insulation
- Corrosion Resistant
- Unaffected by Vibration or Moisture
- Provision for Expansion
- Adequate Ventilation
- Rugged Terminals

Rugged

Built of Steel and Mica—nothing to break. Light in weight yet dependable. Remarkably constant resistance values regardless of temperature or age.

Original Grid Design

Provides a shape assuring maximum ventilation. Heat is evenly distributed. With all parts of grid equally exposed, heat is rapidly dissipated.

For any job

Where constant "trouble free" resistor service is wanted . . . you can safely specify P-G Steel Grid Resistors and get better performance with lower maintenance.

Complete data given in **BULLETIN No. 500** . . . Copy on request.

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THE POST-GLOVER ELECTRIC COMPANY

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221 WEST THIRD STREET, CINCINNATI 2, OHIO

NOW 75 and 100 GALLONS PER MINUTE

with a single

MARVEL SYNCLINAL FILTER

(5 to 100 g.p.m Sizes)

ANSWERING DEMANDS FOR MORE! Ever since Marvel offered its first balanced synclinal filter eight years ago, a 20 g.p.m. model, industry has wanted more and more. Marvel Synclinal Filters reduced down time and cut maintenance costs. Industry's enthusiasm for Marvel Synclinal Filter's outstanding qualities was unprecedented; demand rose for a more complete range of sizes, and Marvel added 5, 8, 10, 30 and 50 g.p.m. models for most commonly required specifications. To add to the versatility of Marvel Synclinal Filters for a wider range of application, a filter enclosed in a housing for line application in hydraulic and in circulating systems was developed. Industry soon wanted still greater capacity units to eliminate multiple installations on machines needing even higher flow rates. Now Marvel again answers demand with new 75 and 100 g.p.m. sizes. The 75 g.p.m. model is only 12½" long overall, 6" in diameter, and the 100 g.p.m. model is only 14" long, 6½" in diameter.

Line Type (Cutaway)

100 g.p.m. Sump Type (Housing Cutaway)

FOR ALL HYDRAULIC AND LOW PRESSURE SYSTEMS

filtering non-corrosive liquids. All sizes available in meshes from 30 to 200. Operate in any position. Line models may be serviced without disturbing pipe connections.

Original Equipment of Over 250 Manufacturers

Write for further information and complete engineering data.

Meets J.I.C. Standards

MARVEL ENGINEERING COMPANY
625 W. Jackson Blvd. Chicago 6, Ill.

WHEREVER THE HOT STUFF HITS

USE NATIONAL CARBON

TRADE-MARK

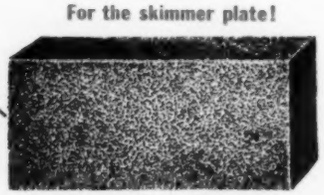
For the cinder notch liner!

For the cinder notch plug!

For the splash plate!

For the runout troughs!

For the skimmer plate!



● "National" carbon is now firmly established for blast furnace linings. It is being used outside the furnace as well—wherever there is contact with molten material—for the splash plate, runout troughs—clear down to the ladle—skimmer plate, cinder notch liner and cinder notch plug.

The reasons?

"National" carbon has no melting point. It is highly resistant to slag attack and thermal shock . . . not wet by molten metal . . . has a low thermal expansion . . . and maintains its mechanical strength at elevated temperatures.

Use "National" carbon inside and outside your blast furnaces and you cut down maintenance, speed up production and save money. For more information, write to National Carbon Company, Dept. E

The term "National" is a registered trade-mark of Union Carbide and Carbon Corporation

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District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

IN CANADA: National Carbon Limited
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Personnel News...

Paul F. Kohlhaas has been appointed assistant vice president—design and appropriation control, United States Steel Co., Pittsburgh, Pa. In this newly created position Mr. Kohlhaas will be responsible for equipment and plant designs and layouts, estimates of construction costs, and engineering control of expenditures. Mr. Kohlhaas came to U. S. Steel in 1941 as chief engineer for the Columbia Steel Co. He was made vice president in charge of engineering four years later, the position he held at the time of his new appointment.

George G. Mueller was named assistant division superintendent, steel producing, Duquesne, Pa., works of U. S. Steel Co. Mr. Mueller has been with U. S. Steel since 1933 when he was first employed in the general offices, Pittsburgh, Pa. In July, 1935 he was transferred to Duquesne works as a quality observer. Since that time he has had various supervisory positions and was superintendent, open hearth prior to his recent advancement. He is a 1935 graduate of Carnegie Institute of Technology where he majored in metallurgical engineering.

W. H. Collison has been named assistant general superintendent, blast furnace division, Great Lakes Steel Corp., Ecorse, Mich. Mr. Collison was formerly superintendent of the coke plant at Great Lakes Steel.

Charles P. Hammond has been appointed general superintendent of Green River Steel Corp., Owensboro, Ky. Mr. Hammond has been superintendent of mills at Rotary Electric Steel Co., Detroit, Mich., since 1948. Green River Steel Corp. has under construction an electric furnace steel producing and rolling mill.

Harvey J. Haughton has been appointed assistant to executive vice president of the Jones & Laughlin Steel Corp., Pittsburgh, Pa. Mr. Haughton was formerly accountant-statistician in the planning and control department.

Wesley N. Gordon was named Pittsburgh district manager of United States Steel Supply Co. Mr. Gordon succeeds **Keith P. Rindfleisch,** who has been appointed Chicago district manager for the company.

Robert P. Bremner has been appointed assistant to the vice president in charge of operations for Youngstown Sheet and Tube Co. Mr. Bremner came to Youngstown late in 1947 as a member of the raw materials department. Eight months later he was appointed mining engineer to deal with all the company's mining problems.

Raymond E. Zimmerman was named chief preparation engineer in the coal division of U. S. Steel Co., Pittsburgh, Pa. Since 1950, Mr. Zimmerman has been chief coal preparation engineer for Koppers Co., supervising the building of coal preparation plants and handling equipment in Turkish coal fields.

John D. Paulus, former senior account executive of Ketchum Inc. and a veteran of 20 years on Pittsburgh, Washington, and New York City newspapers, has been appointed director of public relations for Jones & Laughlin Steel Corp., Pittsburgh, Pa. He succeeds **Earl F. Blank,** who becomes special assistant to the vice president-employee and public relations.

Donald C. Coleman who has been assistant superintendent of coke plant, Republic Steel Corp., Cleveland, Ohio is now superintendent of coke plant, Fairless works, United States Steel Co., Morrisville, Pa.

E. C. Kirkpatrick, works manager, Steel Co. of Canada, Ltd., Montreal, Canada, has retired from active work. Mr. Kirkpatrick has been succeeded by **M. S. Layton.**

Robert M. Lloyd has been elected vice president, raw materials of United States Steel Co., Pittsburgh, Pa. Mr. Lloyd was appointed assistant to vice president of the former United States Steel Corp. of Delaware in December 1945, and became assistant vice president of United States Steel Co. on January 1, 1951.

L. L. Meikle has been named president of the Lincoln Engineering Co. of California. Mr. Meikle joined Lincoln of California in 1939 and has been general manager since 1941. He succeeds **C. Homer Redd** who will serve in an advisory capacity.

PAUL F. KOHLHAAS

GEORGE G. MUELLER

W. H. COLLISON

CHARLES P. HAMMOND

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YOUR BRUSH PROBLEM TO
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Manufacturers of Morganite Self-Lubricating Carbon Specialties including Seals, Rings, Valves, Slides, Bearings, etc., and Carbon Piles

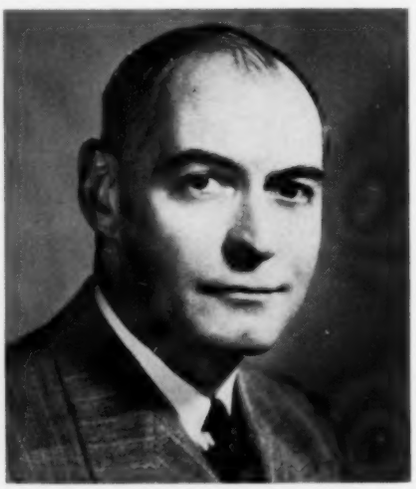
J. D. Scully, general maintenance foreman, National Tube Co., McKeesport, Pa. has retired from active service.

Sam Littlejohn has been elected commercial vice president of the General Electric Co. Mr. Littlejohn, formerly manager of the Atlantic district office of the company's apparatus organization in Philadelphia, Pa., will be engaged in customer relations activities with headquarters in Cleveland, Ohio.

Donald F. Warner has been appointed assistant to the manager of engineering for the General Electric Co.'s turbine department.

Robert C. Becherer has been elected executive vice president of Link-Belt Co., Chicago, Ill. Mr. Becherer was elected vice president last March. He joined Link-Belt in 1923 upon graduation from Purdue University in chemical engineering and has been general manager of the company's Ewart plant in Indianapolis since 1947.

Adger S. Johnson has been appointed president of National Carbon Co., a division of Union Carbide and



ADGER S. JOHNSON

Carbon Corp. Mr. Johnson has been vice president and general manager of National Carbon Co. since May 1950.

R. Robert Zisette, Gunnar Palmgren, Eric C Brodin and **Karl Kesselring** have been elected vice presidents of SKF Industries, Inc., Philadelphia, Pa. Mr. Zisette is in charge of sales, advertising and market research; Mr. Brodin, manufacturing development; Mr. Palmgren, engineering and research, and Mr. Kesselring, production.

G. R. McDermott, vice president, Surface Combustion Corp., Toledo, Ohio, has retired from active service. After spending several years with General Electric Co., Bethlehem Steel Co., and U. S. Steel Co., he became vice president and general manager of former Chapman-Stein Co., Mt. Vernon, Ohio. This firm was acquired by Surface Combustion Corp., in 1930 and he was made vice president in charge of steel mill engineering and sales. Mr. McDermott, a Life Member of the AISE was a member of the first combustion committee. He received the Sir Robert Hadfield award in 1923 for a paper presented before the Iron and Steel Institute on

50" STRIP MILLS INSTALLED AT RANSHOFEN, AUSTRIA

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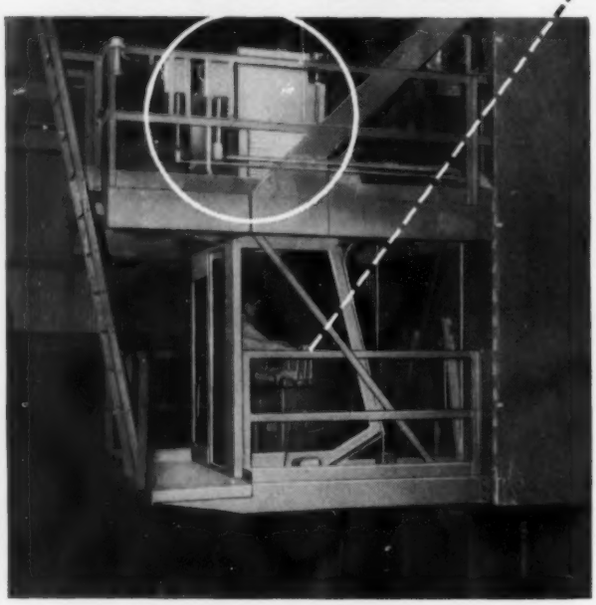
NOW - 60° F.
---COOLER INSIDE---



for this stripper crane operator at Ford Motor Co.

MAJOR WORKING HAZARD ELIMINATED FOR RIVER ROUGE PLANT CRANE OPERATORS

Extreme temperatures up to 140° F. around stripper cranes like this one at Ford Motor Co. limit an operator's working endurance. Dravo Crane Cab Coolers are designed to lower the cab temperature to 80° F. providing operators with greatly improved working conditions. Not only is the crane operator's health safeguarded but his alertness and efficiency are much increased.

CRANE CAB COOLERS HAVE LONG SERVICE LIFE, PROVIDE YEAR-'ROUND AIR CONDITIONING

Dravo Crane Cab Coolers are ruggedly constructed, factory assembled and pre-tested to provide years of more-than-satisfactory service. All equipment in the unit is readily accessible with ample space for quick and efficient maintenance.

In the various air conditioning functions the crane cab cooler not only filters the air, removes dust, dirt and fumes, but heats the cab in winter, cools it in summer and provides constant ventilation the year around.

AVAILABLE IN SINGLE UNIT OR IN SPLIT-TYPE UNIT: IMMEDIATE DELIVERY

Dravo Crane Cab Coolers are built in two models—the self-contained unit, mounted on any available space on the crane and the new split-type unit where the condenser section is mounted on the crane, with the conditioning section in cab.

The Dravo Crane Cab Cooler can be easily and quickly installed on any type of crane with a minimum of down-time required. Units are available now! Write for more information —or phone the nearest Dravo Office and have our representative call on you.

DRAVO CORPORATION

602 Dravo Building, Fifth & Liberty Avenues, Pittsburgh 22, Pa.

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NEW YORK • PHILADELPHIA • PITTSBURGH

"The Heat Balance and Thermal Efficiency of the Open Hearth Furnace."

John P. Roche, vice president and general sales manager of Heppenstall Co., Pittsburgh, Pa., has been promoted to executive vice president. **Harry O. Lang,** vice president of Heppenstall Co., Detroit, Mich., a

JOHN P. ROCHE

subsidiary company, will succeed Mr. Roche as vice president in charge of sales of the parent company. Mr. Lang will make his headquarters at the Pittsburgh general offices. **Raymond T. Porter,** of Bridgeport,

HARRY O. LANG

Conn., eastern sales manager, will take over Mr. Lang's duties in Detroit. **George H. Wurster,** sales representative in the Boston area, has been named eastern sales manager.

R. M. Casper has been placed in charge of the newly established power department of Allis-Chalmers Manufacturing Co., Milwaukee, Wisc. The new department was formed by combining the electrical and mechanical power departments. Mr. Casper has been manager of Allis-Chalmers electrical department since 1949. Other new power department appointments include **F. W. Bush,** assistant manager in charge of the electrical sections; **C. C. Jordan,** assistant manager in charge of the mechanical sections; **R. N. Miers,** manager of the steam turbine section; **C. R. Braun,** assistant to R. M.

"Tycol Anepro carries heaviest loads... lowers bearing failure...slices lubrication costs"

Indeed it does! Tycol Anepro Greases measure up to severest shock-load conditions encountered in the rolling of steel. They protect bearings from moisture, heat, and abrasive impurities. Anepro's exceptionally high film strength and non-corrosive properties result in far longer bearing life . . . faster rates of production . . . minimum down-time for heavy-duty equipment.

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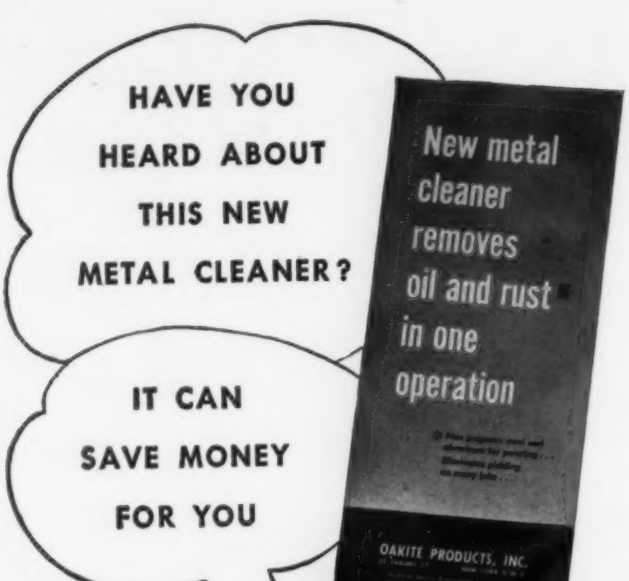
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IT CAN SAVE MONEY FOR YOU
New metal cleaner removes oil and rust in one operation
OAKITE PRODUCTS, INC.

Oakite Compound No. 33

REMOVES OIL
at the same time that it
REMOVES RUST...
And at the same time it prepares the metal for painting

Oakite Compound No. 33 is a great soak cleaner for steel, cast iron, aluminum sheet and castings. It removes oil, rust, heat scale, other oxides, carbon smut, soldering and welding residues, identification inks and other soils. *It frequently eliminates pickling operations on moderately rusty steel.*

Oakite Compound No. 33 is great for hand-swabbing on metal surfaces too large to be soaked in tanks. It can save money for you in many ways.

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MATERIALS • METHODS • SERVICE
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Casper, and **E. J. Schiebenes,** office manager of the power department.

H. V. Rasmussen has been appointed executive engineer at the Wellsville, N. Y. plant of Worthington Pump and Machinery Corp. Mr. Rasmussen has spent a number of years with both the Westinghouse Electric Corp. and the DeLaval Steam Turbine Co.

Edward J. Roesch has been appointed superintendent of the Meadow Lands, Pa., plant of the Brake Shoe & Castings division, American Brake Shoe Co., and **Thomas P. Wallace** has been appointed superintendent of the division's Buffalo, N. Y., plant.

Harry J. Noles has been appointed manager of the air filter division of the American Air Filter Co., Inc., Louisville, Ky., to succeed the late **Howard W. Pound.** Mr. Noles, formerly assistant manager of the division, joined the company in 1928 while still a student at the

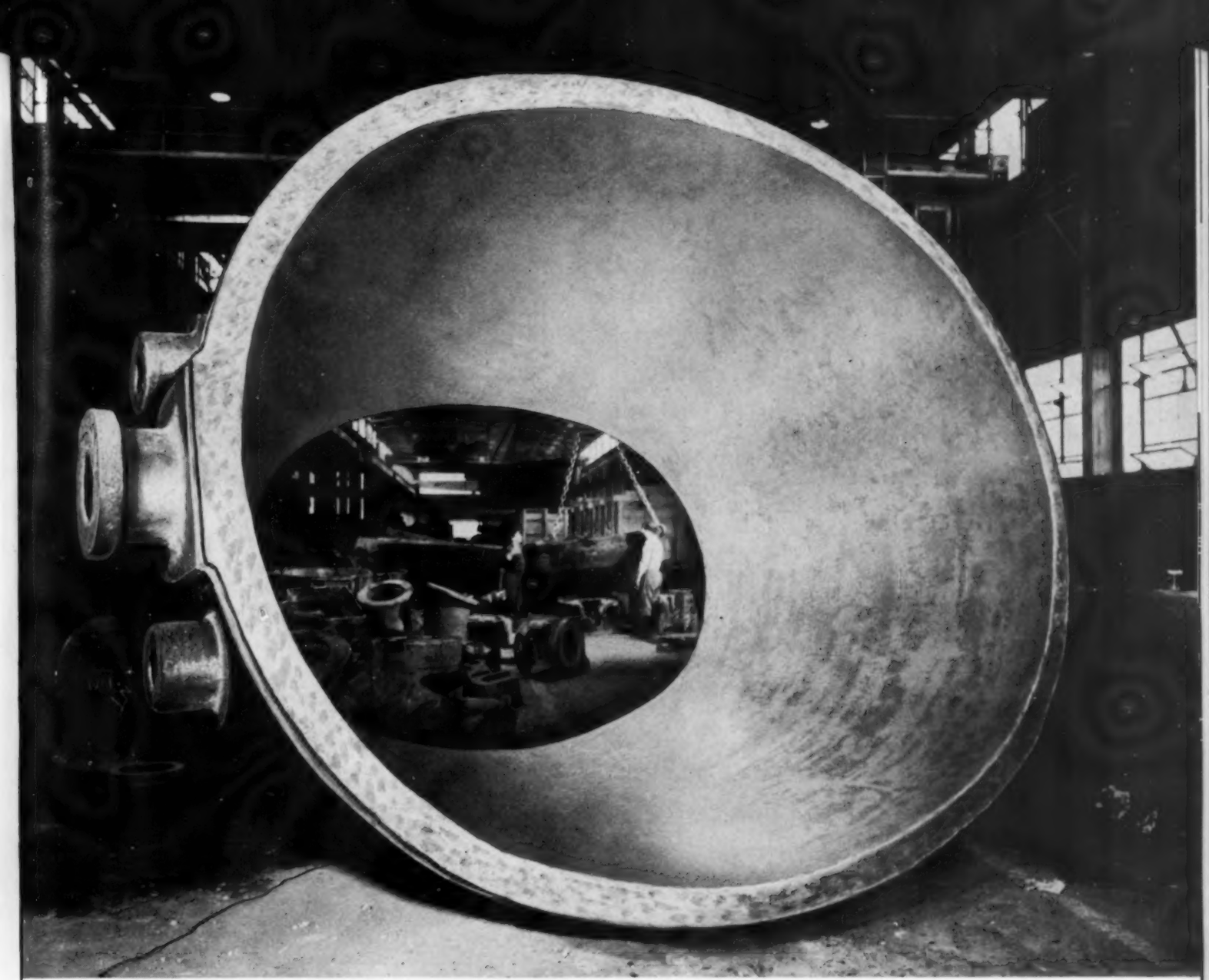
HARRY J. NOLES

University of Kentucky where he studied mechanical engineering.

G. J. Christner of Eagle-Picher Sales Co., Cincinnati, Ohio, was elected president and chairman of the board of the Industrial Mineral Wool Institute at its tenth annual meeting on September 26 at Hot Springs, Va. Mr. Christner, vice president and general manager of Eagle-Picher's insulation division, was vice president and a director of the institute during the last year. At the Hot Springs meeting, **H. W. Elkins** of Owens-Corning Fiberglas Corp., Toledo, Ohio, was elected vice president and **Frank Christenson** of Refractory and Insulation Corp., New York, N. Y., named treasurer of the institute.

Karl H. Meyer, who has been manager of the Ashtabula, Ohio, plant of Reliance Electric & Engineering Co. since its completion in early 1947, will return to Cleveland December 1 as manager of the company's Ivanhoe division. Mr. Meyer will be succeeded in Ashtabula by **Walter H. Haber** who accompanied him there as production manager when the plant was opened four years ago.

E. C. Norway, for the past four years consulting and director of engineering for Acindar Industria Argentina, S. A. is now consulting engineer with Northwestern Steel and Wire Co. at Sterling, Ill.



THIS SLAG POT WILL EXCEED NORMAL "LIFE-EXPECTANCY"

Whether it's a slag pot or any steel casting, unusual stresses, strains, shock, abrasion, fatigue—are all considered before "Union" makes a mold or pours a heat.

So, whatever the size, configuration, quantity, or metallurgy involved, "Union" always comes through with exactly what the customer requires —*plus* an extra measure of quality due to casting practices and techniques developed and acquired in over fifty years' experience.

"UNION" makes better— **GEARS AND PINIONS . . . UNIVERSAL COUPLINGS . . . CHARGING BOXES . . . PEELS . . . BLAST FURNACE BELLS AND HOPPERS . . . SLAG POTS . . . STEEL MILL CARS . . . SPECIAL STEEL CASTINGS.**

UNION STEEL CASTINGS

DIVISION OF BLAW-KNOX COMPANY . . . PITTSBURGH, PA.

OWARD F. BRENHOLTS

NEWBOLD C. GOIN

ERSON V. OGG

JOHN C. SEARS

Howard F. Brenholts has been elected president of the newly organized firm of Brenholts, Goin, and Ogg, Inc. **Newbold C. Goin** and **Erson V. Ogg** have been elected vice presidents. The new firm was incorporated as a management consulting organization. Offices will be maintained at 201 East Carson St., Pittsburgh 19, Pa.

John C. Sears has been appointed as executive secretary of the American Gear Manufacturers Association with headquarters in Pittsburgh, Pa. **Newbold C. Goin,** the former executive secretary has affiliated with Brenholts, Goin & Ogg.

Peter T. Hopper and **James H. Sutherland** have been promoted to new duties in the Pittsburgh, Pa., office of SKF Industries, Inc. Mr. Hopper has been named Pittsburgh district manager, Mr. Sutherland becomes field engineer for the Pittsburgh district. Mr. Hopper joined SKF in a sales capacity in 1923, and has been in the Pittsburgh office since 1931. Mr. Sutherland, employed by Youngstown Sheet and Tube

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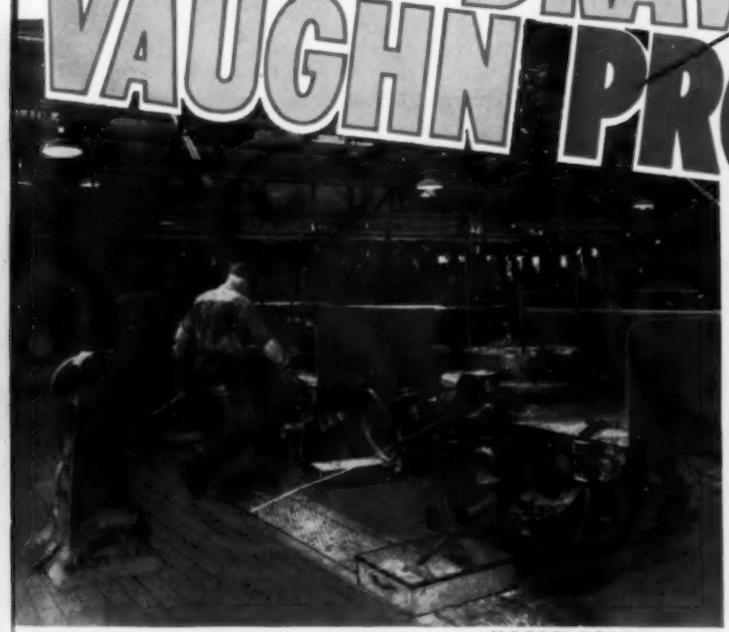

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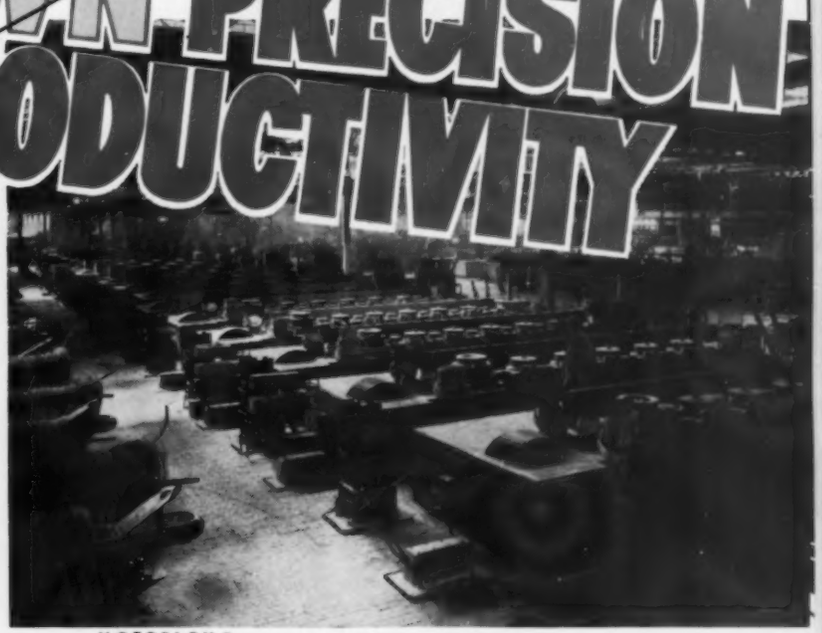

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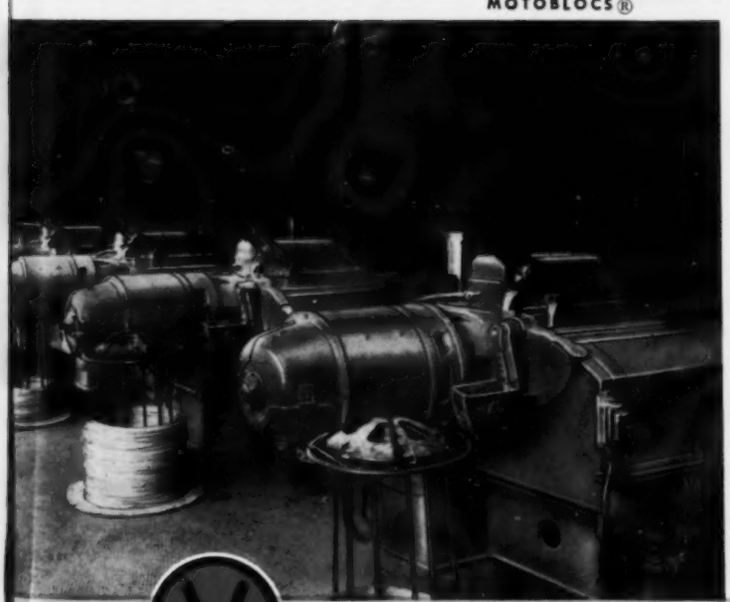

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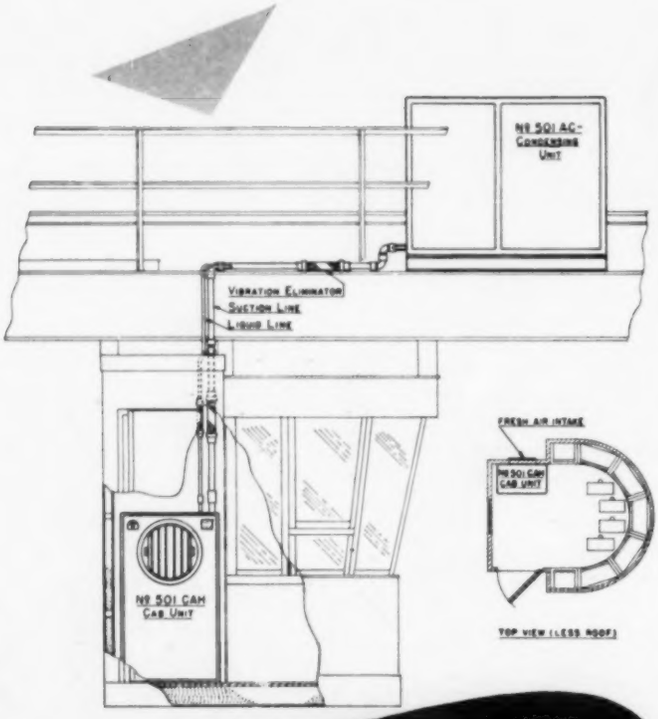
COMPLETE COLD DRAWING EQUIPMENT . . . Continuous or Single Hole . . . for the Largest



How to Save 2/3 on Your Crane Cab Air Conditioning

By arranging for air conditioning with the Lintern Aire-Rectifier *when buying the crane,* the cost is only about one-third that of installing air conditioning later.

A majority of the steel companies, in their expansion programs, have included air conditioned crane cabs.

Aire-Rectifiers hold cabs at a cool 85° F and relative humidity of 30% to 50% at ambient temperatures of 170° without excessive head pressures or wear on the machine.

In the split system (shown above) the condenser is located at any convenient place on crane, and evaporator (cooling coil) is placed in cab. The two units are connected with refrigerant lines properly secured and protected against breakage. Condensers are air-cooled, assuring trouble-free service with but little maintenance.

May we send you complete information on the Lintern Aire-Rectifier (patents pending) and its application to your particular needs?

THE LINTERN CORPORATION

29-2 RIVERSIDE DRIVE • BEREA, OHIO

Co., upon graduation from Carnegie Tech, has been steel plant division senior engineer since 1943 at SKF's main office in Philadelphia, Pa.

R. W. Berg, sales engineer connected with National Roll & Foundry Co., Avonmore, Pa., is now affiliated with the National Grinding Wheel Co., with offices in the Grant Building, Pittsburgh, Pa.

Donald A. King has joined Pennsylvania Salt Manufacturing Co.'s sales-service organization in the industrial chemicals department. Mr. King will make his headquarters at the company's sales office in Detroit, Mich., and has been assigned to the territory in that area.

Obituaries

Bernard A. Gallagher, 51, representing Electric Service Manufacturing Co. in the Pittsburgh, Pa., district, since January 1951, died October 8. Mr. Gallagher formerly represented Electric Service in the Buffalo, N. Y. area.

Howard W. Pound, 55, vice president and manager of the air filter sales division, American Air Filter Co., Inc., Louisville, Ky., died October 10.

Henry H. Erkelenz, 72, retired vice president and member of the executive committee of Harnischfeger Corp., Milwaukee, Wisc., died October 6.

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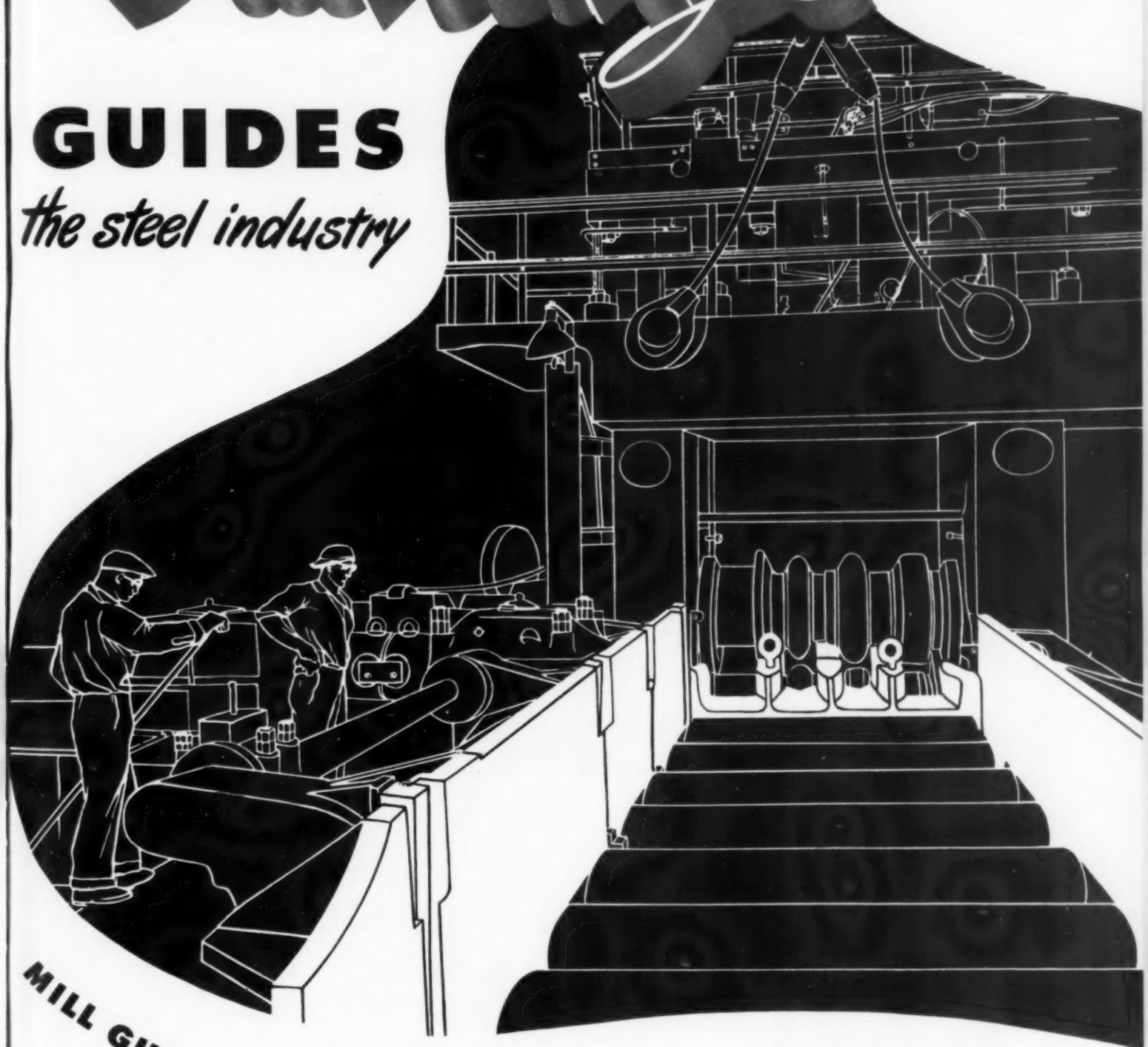
GUIDES

the steel industry



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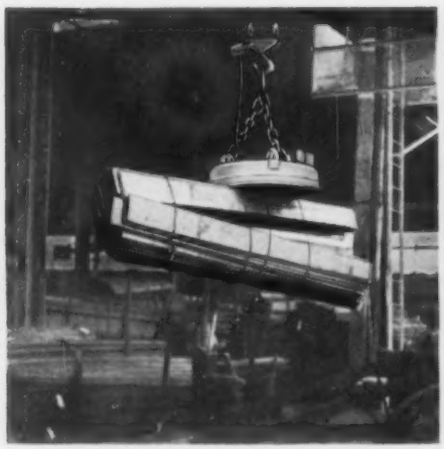
Youngstown Alloy Casting Corp.
Youngstown, Ohio

IT TAKES *PULL* FOR THESE JOBS AND EC&M LIFTING MAGNETS HAVE IT!

Wind-blown scrap—EC&M Magnet gathers it in.

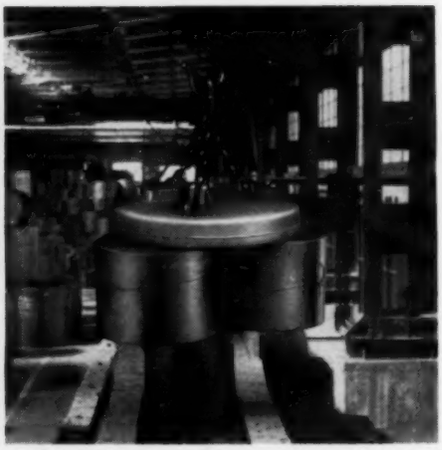
EC&M Magnet lifts drop ball by point contact.

Too hot to handle—EC&M Magnet keeps castings on the move.



Saves hook-on time—EC&M Magnet lifts the load as soon as contacted.

EC&M Magnets load and unload coils for journey to the tin mill.



EC&M Magnet empties conveyor as fast as coils come from the hot mill.

The OVER-ALL PULL of an EC&M Lifting Magnet keeps costs down—profits up. Full payloads—working without groundmen—no hook-ons to pinch fingers. The EC&M Type SW Lifting Magnet is *all-welded*—keeps moisture out—no bolts to stretch, both inner and outer pole shoes are welded tight—better proportion for coil space because bolt-head recesses are eliminated. Send today for EC&M 16-page Bulletin 900 describing EC&M *All-Welded* Lifting Magnets.

WRITE FOR BULLETIN 900

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET • CLEVELAND 4, OHIO

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MIXER TYPE HOT METAL CARS

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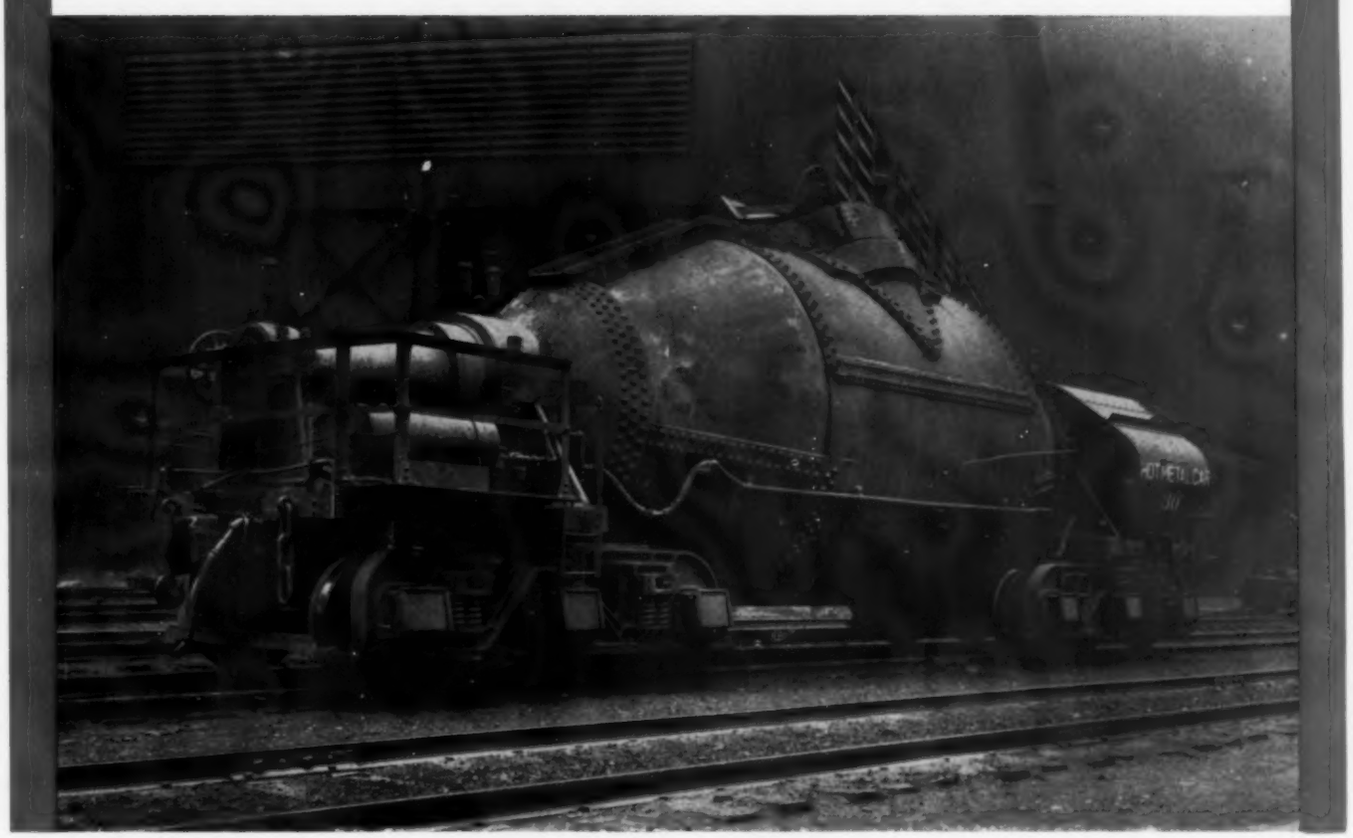
OPERATING COSTS



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75 to 210 Net Tons

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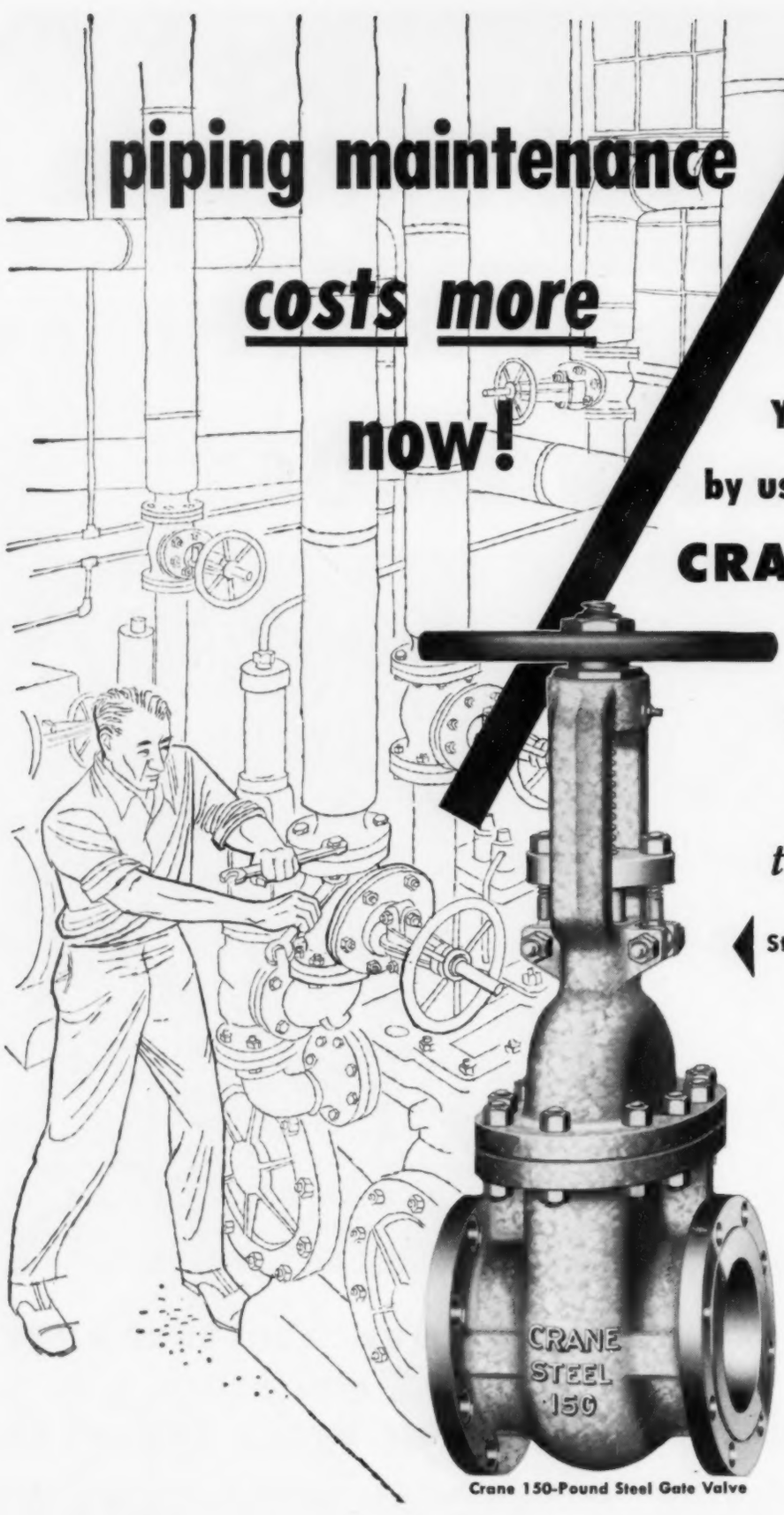
piping maintenance *costs more* now!



Crane 150-Pound Steel Gate Valve

You spend less for it by using Dependable Quality

CRANE VALVES

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Steel valves that stay on the job

You can practically forget valve maintenance worries with Crane Cast Steel Wedge Gates. They're unusually rugged . . . amply reinforced at all stress points. Disc is precision-guided to reduce seating surface wear. Straight-through ports give smooth flow, with minimum turbulence and erosion.

Stuffing box depth and design assure tight stem seal . . . long packing life. Valves available in trim materials for steam, water, gas, oil, and oil vapor services.

Ask your Crane Representative about the better quality and greater dependability of Crane valves—your assurance of on-the-job performance that spells lower final cost.

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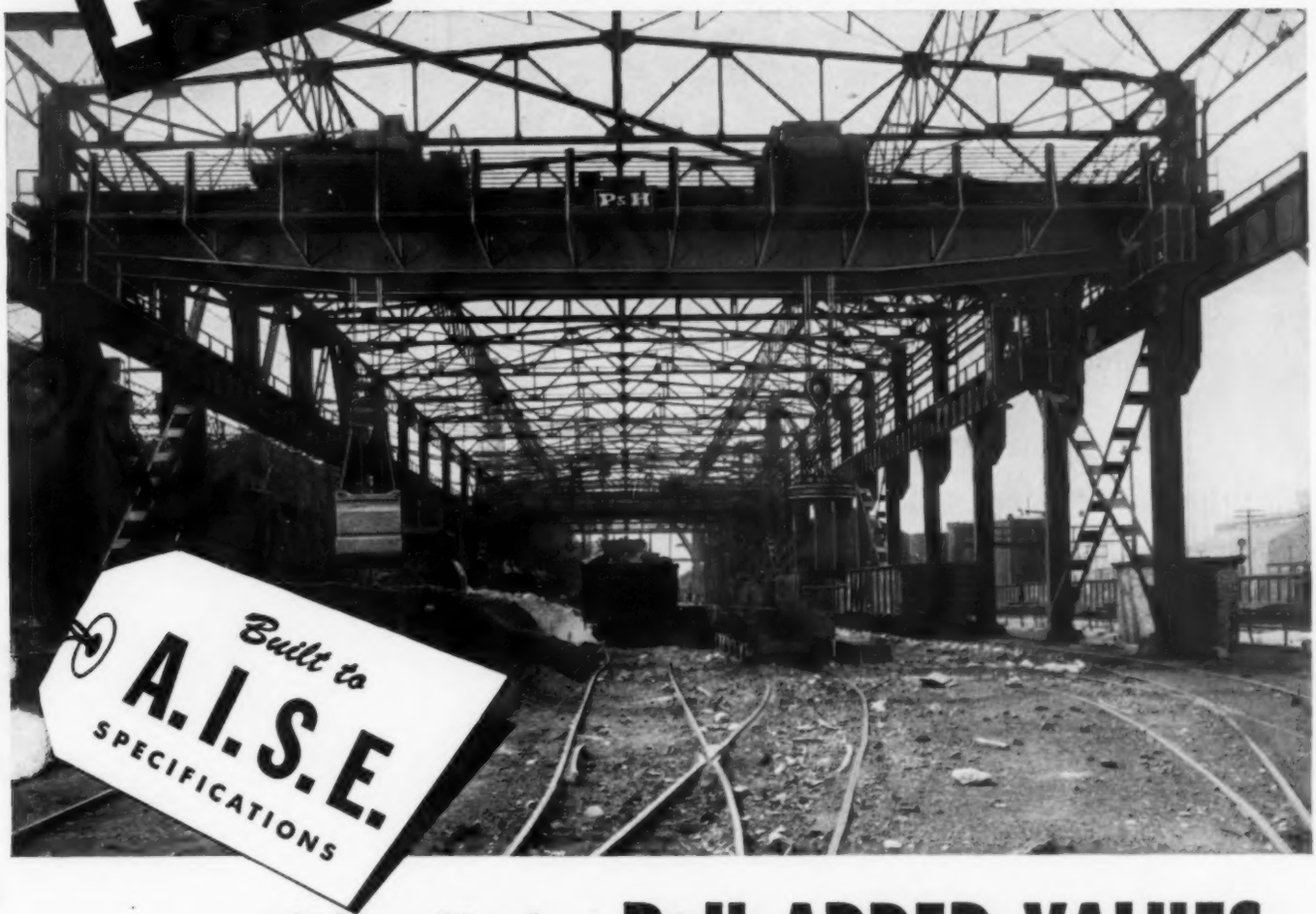
P&H MILL TYPE CRANES



. . . with all the P&H ADDED VALUES Steel Men want!

Three Gear Case Bridge Drive
delivers motive power to end trucks, perfectly equalized. Mill motor is connected to gear case at center of span, which transmits power equally to the gear cases in front of each end truck.

No Open Gears at Trucks—
gear reductions are completely enclosed in sturdy all-welded cases. All gears run in oil — quietness and long life are insured with all gears operating in oil baths. No exposed gears; no dripping grease.

Flexible Couplings at Wheel Shafts
assure smoother starts — maximum bearing life and prevent thrust from entering gear cases.

Split Gear Cases
are designed to simplify inspection and maintenance.

Large Diameter Cross Shaft
combines maximum strength with low torque to minimize strain.

Hoist Sheaves
readily accessible from trolley deck. All hoist gears, including drum gear and pinion, run in oil.

Trolley Frame
and bridge ends are line bored and milled.

P&H Motors,
brakes and controls are available.

These and many other Added Values explain the preference which accounts for more than 2,000 P&H Cranes in steel mills. P&H Mill Type Cranes are described in Bulletin C-42. Ask for your copy.

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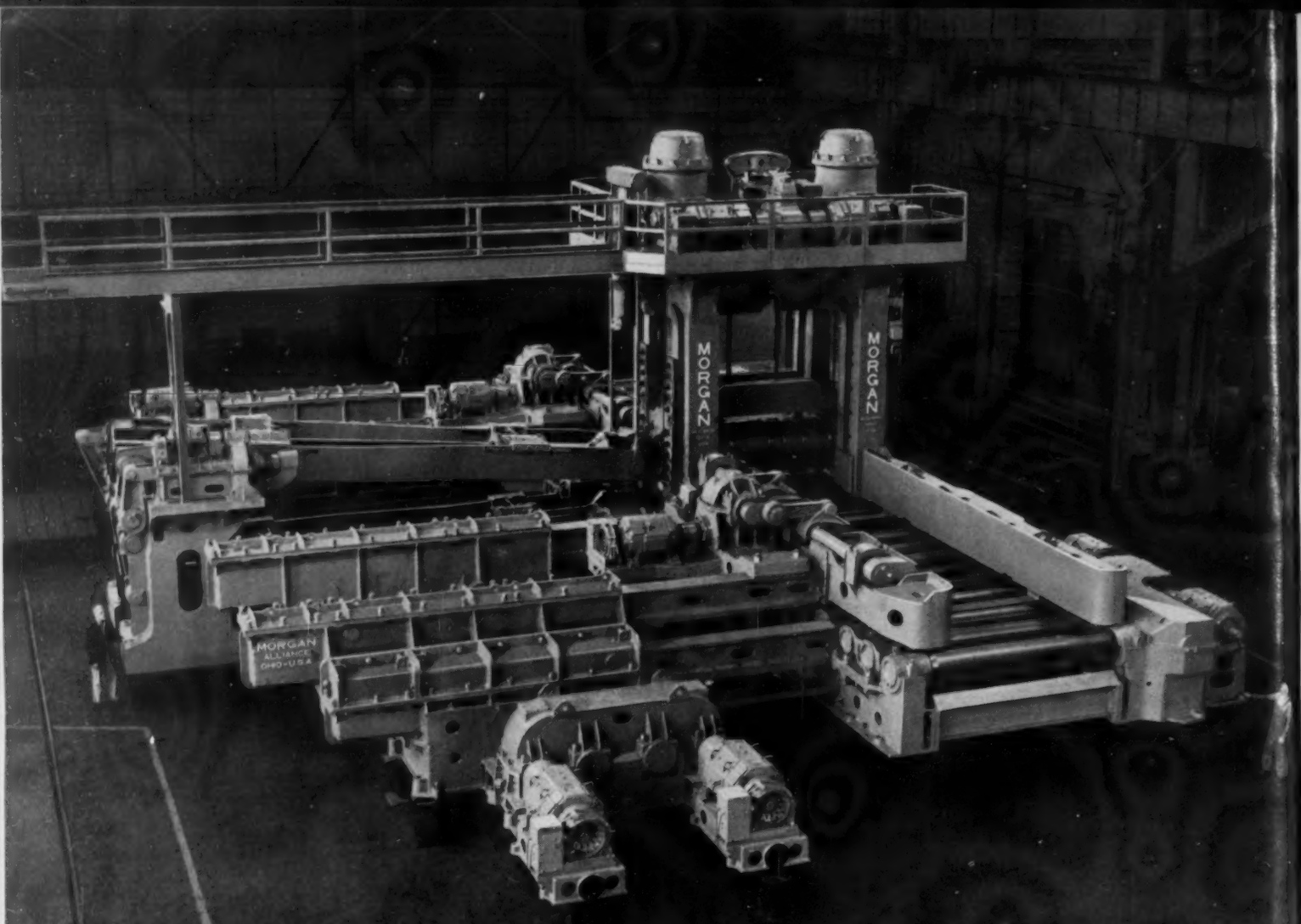
POWER SHOVELS • CRAWLER AND TRUCK CRANES • OVERHEAD CRANES • HOISTS • ARC WELDERS AND ELECTRODES • SOIL STABILIZERS • DIESEL ENGINES • PRE-FAB HOMES



44" TWIN MOTOR DRIVE BLOOMING MILL

Morgan 44"—2 High Reversing Blooming Mill to be direct connected to two 4000-Hp., 50/120 Rpm. Motors. Top roll and both spindles are hydraulically balanced by individual cylinders connected to an air hydraulic system. Speeds of motor driven screw down, feed rollers, mill tables and manipulator are regulated by variable voltage control.

Mill tables have box type cast steel girders. Rollers are forged steel equipped with anti-friction type bearing cartridges. All gears have hardened teeth, are totally enclosed and operate in oil. Manipulator is of the electric overhead type with retractable heads affording maximum accessibility to all parts of the mill tables.

We design and build mills and mill machinery for the steel industry. For your next mill and equipment, consult—

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Equipment News...

NEW ORE BRIDGE

▲ A new ore bridge with a free digging stocking capacity of 1165 tons of ore per hour has been erected for Carrie Blast Furnaces 6 and 7 of United States Steel Co.'s Homestead, Pa., district works.

The structure, with a 186-ft span, has a bucket capacity of 15 tons and was designed to supplant two 7½ ton ore bridges.

Dravo Corp. fabricated the entire structure, except the main span which was built by American Bridge Co. The latter company also erected the new ore bridge which has an overall weight in excess of 600 tons.

The bridge, running on rails, stockpiles ore from railroad cars and supplies ore to the conveying mechanism which charges blast furnaces.

The main span of the bridge is supported on two legs, one of which is 80 ft high and the other 60 ft, from the runway to the bottom chord of the span. The shear leg, which is connected to the span by ball and socket joints to permit skewing of the bridge 1/15 the distance of its length, is 70 ft wide at its base. The pier leg is 60 ft wide.

Each of the legs is supported on two eight-wheel truck units. A separate 45-hp electric motor drives each truck unit, turning all eight wheels through worm and spur gearing. The wheels are 27 in. in diameter.

Dravo-designed rail clamps are installed on the trucks to hold the bridge stationary. These clamps operate automatically in case of power failure and if the wind velocity reaches 45 miles per hour as indicated by an anemometer mounted atop the main span. The bridge operator also has push button control over the rail clamping mechanism.

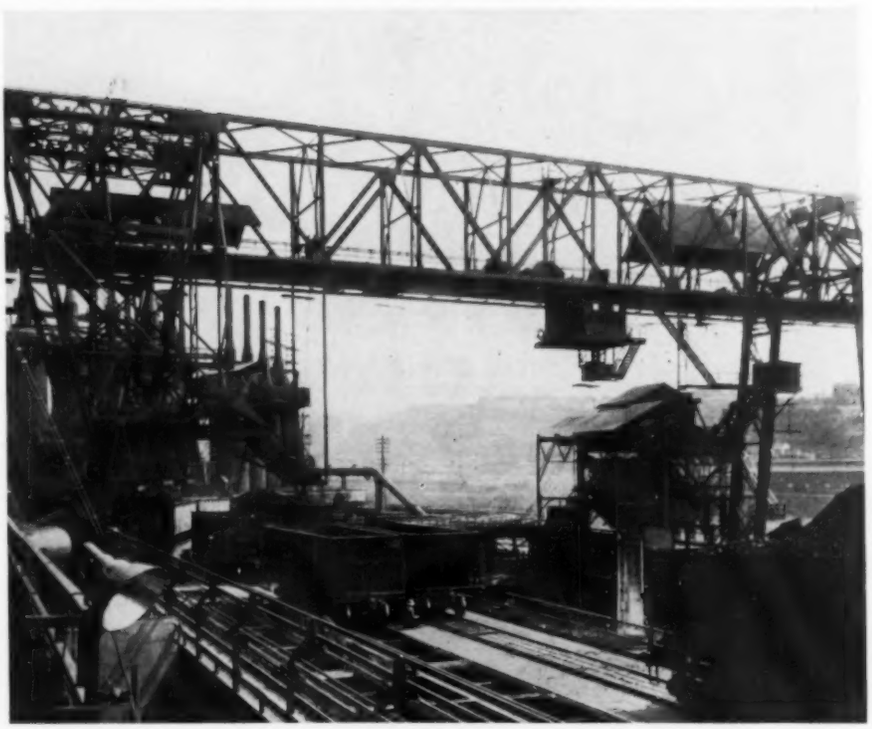
To operate the bridge and its equipment, a total of 11 electric motors are required. Combined horsepower of these motors is 888½ at varying time ratings.

Both the pier leg and shear leg are of all welded construction while the main span is riveted. Structural members of the legs, and the trolley and bridge trucks, were prefabricated at Dravo's Neville Island plant and shipped to the erection site.

Hydraulic buffers have been installed at each end of the trolley runway to absorb the impact of the trolley at full speed.

On an average operating cycle, the trolley can make a round trip from the unloading trough to the center stockpile in 51 seconds. Bucket hoist speed is 200 fpm; bridge travel is rated at 100 fpm, and the average duty cycle speed of the trolley is 600 fpm.

This new ore bridge has a span of 186 ft and a bucket capacity of 15 tons. It was designed to supplant two 7½ ton ore bridges.



AIR POLLUTION

▲ A research and development project aimed at reducing that part of air pollution resulting from fly ash and cinders emitted by steam locomotives is making important progress.

This research is jointly sponsored by the railroads serving Allegheny County, Pa., and the bituminous coal industry through its research agency, Bituminous Coal Research, Inc.

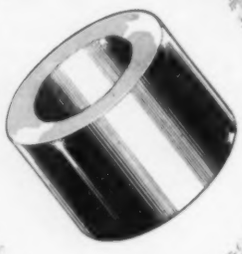
The project was initiated late in 1949 in order to develop methods by which railroads could comply more effectively with the provisions of a new county smoke ordinance. The specific objective was research on the design, construction, and testing of a cinder and fly ash collection and disposal system suitable for conventional steam locomotives, which would reduce stack emission of solids 75 per cent by weight.

Performance tests with conventional collection and reinjection methods reduced the stack emission about 50 per cent by burning on the grate part of the carbon in the coarse reinjected cinders. Since this percentage reduction did not meet the objective of the research, it has been necessary to explore all possible methods through which a further reduction in stack emission could be made.

A promising approach is now being explored. Equipment will be experimented with to determine whether the remaining cinders can be reduced to a size which will permit the carbon content to be burned within the space limitations of the locomotive firebox.

Presently the system being investigated is: (1) cinders are collected and classified in the collector, (2) coarse

WORKS WHERE OTHERS WON'T



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cinders are returned to the locomotive firebox and burned on the grate, and (3) the remaining cinders are pulverized and returned to the firebox for burning in suspension.

It is anticipated that fuel savings resulting from the installation will pay for the added equipment in a short time.

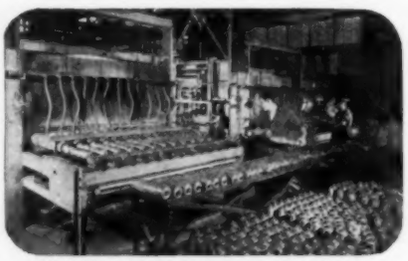
When laboratory studies show a satisfactory approach to this problem, full scale equipment will be constructed and tested at the Pennsylvania Railroad's test plant at Altoona, Pa.

POWER DISTRIBUTION

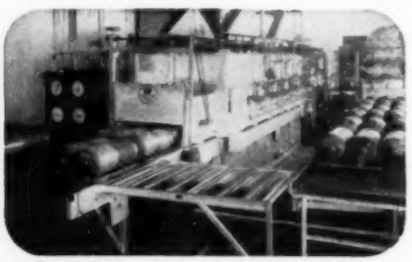
▲ Metal-enclosed switchgear has long since become almost the universal choice of the steel industry for distributing a-c power at all voltages under 15 kv.

General Electric's line of metal enclosed drawout type switchgear is fully suitable for application on heavy d-c power distribution systems such as are commonly encountered in many types of mill installations. This equipment used the well known heavy duty type MC-5 air circuit breaker in a completely metal enclosed structure which embodies the draw-out feature along with a compact sturdy bus arrangement and dead front control and instrumentation equipment mounted on swinging panels on the front of the structure. This equipment is completely assembled and tested at the factory and shipped assembled in unit groups as large as handling facilities will permit. Installation is as quick and simple as other types of metal-enclosed gear. The equipment can be built into unit substation arrangements with metal enclosed pumpless rectifiers and their transformers.

Other desirable features of this equipment include: Positive mechanical interlocks to prevent inserting or withdrawing the breaker unit unless the breaker is open. Interchangeable removable units of like rating. A negative disconnecting device built integral with the positive breaker unit of single breaker feeder units permitting complete feeder isolation without the use of negative switches. Easily accessible terminal facilities for cables



Shell Forgings 75 mm, 90 mm, 105 mm and other sizes are scale-free hardened, uniformly, automatically and continuously, in these and other EF gas fired installations.



Gas Cylinders Compressed gas cylinders or tanks are continuously normalized and annealed—scale-free, inside and out—in this and other EF gas fired furnaces.

Typical EF Furnace Installations for Defense Production

We have the drawings and have already built these and many other defense production furnaces. Years of experience and complete manufacturing facilities enable us to give dependable service on furnaces for treating jet or propeller type engine parts; tank, automotive or aircraft parts; armor plate; metal powder products, ammunition components and other defense products.

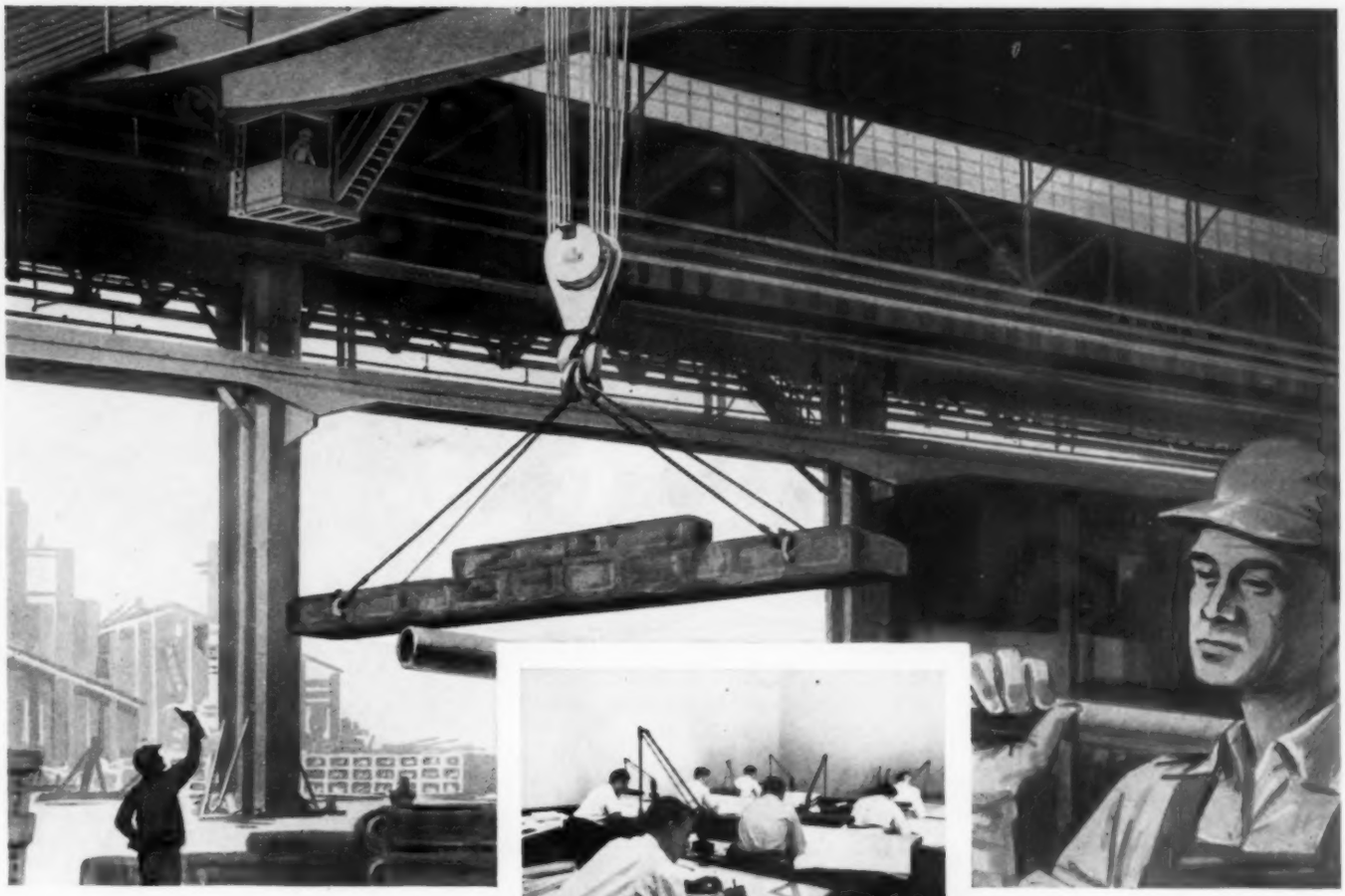
Ask for Bulletin 461-DP

THE ELECTRIC FURNACE CO. · SALEM, OHIO

GAS, OIL OR ELECTRIC FURNACES, FOR ANY PRODUCT, PROCESS OR PRODUCTION

Aircraft Parts Propeller blades are uniformly heated and quenched in this EF continuous furnace. Types available for other propeller and jet type engine and aircraft parts.

Shell Cases A battery of EF gas fired radiant tube continuous special atmosphere, clean annealing and stress relieving furnaces. Other types available for steel or brass.



KULJIAN ENGINEERING saves manpower for STEEL

Kuljian engineering services often save manpower in more than one way. There is the obvious saving of load on the client's own engineering staff when growing needs for plant space or modifications require extra engineering help in designing and supervising new construction.

Then there is the saving of production manpower when new plant design provides for greater efficiency, faster internal transportation, and use of mechanical improvements to increase production per man-hour. In this type of saving, Kuljian brings to your undertakings fresh viewpoints and long experience.

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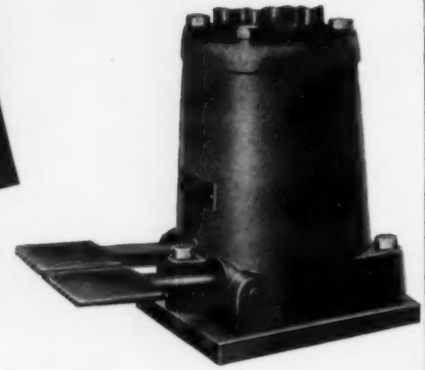
Quick-As-Wink
AIR AND HYDRAULIC
Control Valves



No. 3401-R-4
½ Inch 4-Way
Foot Valve

FOOT OPERATED Air Valves

Increase output of hammers, shears, presses, etc.

● Operators have both hands free to handle the work—speeding production. Valving mechanism has stainless steel body and push-pull rods, brass sleeves, self-sealing U-packers and many other refinements, all fully enclosed against dirt, assuring long efficient trouble-free operation. Convenient pipe connections. No metal to metal seating. ⅜″ to 1″ sizes, 3-way and 4-way, neutral position and regular actions. *Write for full details.*

THE HIGHER THE PRESSURE THE TIGHTER THE SEAL

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AIR AND HYDRAULIC
Control Valves

Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

Mfd. by C. B. HUNT & SON, INC., 1987 East Pershing St., Salem, Ohio

entering from either above or below. Easy withdrawal of breaker units without interfering with the control side of the equipment.

RIVET-CLIP FURNACE DOOR

Shown is the first installation of the new rivet-clip furnace door recently developed by Blaw-Knox Co. for use with a rammed lining. Feature of the design is the use of special spring clips and rivets with countersunk heads to reinforce the lining and give it long service life. This design eliminates the need for welding in new studs when the door is relined.

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● Since 1909, our job has been to create and develop special electrical rotating equipment. This specialization assures equipment designed and built to your exact requirements... guarantees greater dependability, longer life, less maintenance.

Return coupon for information on our Custom-Engineered a-c and d-c motors and generators . . . induction motors . . . battery chargers . . . frequency changers.

Our nation-wide sales engineering and service organization stands ready to meet all User requirements.

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Attach coupon to your letterhead for your copy of Bulletin 2-200.

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Give

It's a BIGGER Red Feather This Year!

EQUIPMENT FOR FAIRLESS

▲ Aetna-Standard Engineering Co. is now manufacturing a large quantity of sheet and tin mill equipment for the United States Steel Co.'s new Fairless works, near Morrisville, Pa.

Contracts awarded to Aetna-Standard include the following equipment to handle cold reduced sheet product one 80 in. sheet side trimming, slitting, and recoiling line; one 80 in. sheet side trimming and shearing line; and one 56 in. sheet side trimming and shearing line.

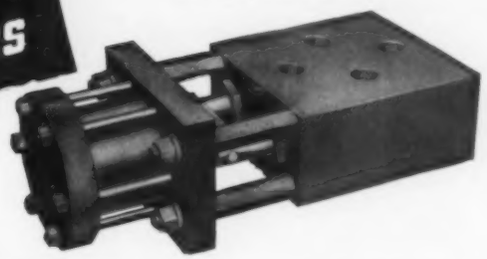
These shearing lines will incorporate improved sheet pilers and many other features which will give high production for this equipment. All lines are designed for high operating speeds.

Aetna-Standard is also furnishing a sheet stretcher leveller of their improved type for the sheet mill division.

The equipment being furnished for the tin mill division will include a complete hot dip tin house with all auxiliaries; one side trimming and shearing line to be used in connection with the hot dip tin stacks and one

Quick-As-Wink AIR AND HYDRAULIC Control Valves

¾ Inch 4-Way — 5000 p.s.i. Piloted Hydraulic Valve



PILOT OPERATED Hydraulic Valve

For hydraulic systems to 5000 p.s.i.

● Designed for controlling double acting hydraulic cylinders. The pilot cylinder is controlled by any type of 4-way air valve and is operated either automatically or manually from a convenient control station. Machined steel housing, hard chrome plated ground and polished stainless steel plungers, molded packers sealed by valve pressure. All parts readily accessible without disturbing the piping. ½" to 4" sizes. *Write for full details.*

THE HIGHER THE PRESSURE THE TIGHTER THE SEAL

Quick-As-Wink AIR AND HYDRAULIC Control Valves

Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

Mfd. by **C. B. HUNT & SON, INC., 1984 East Pershing St., Salem, Ohio**

UNIFORM descaling

with the Spraying Systems Descaling Nozzle

This hardened stainless steel nozzle provides a constantly uniform flat spray for clean descaling operations . . . all streaking is eliminated. Available in wide range of capacities.

LARGE DIAMETER ORIFICE

Note that the orifice is almost circular in shape . . . far less tendency to clog than the "old style" slotted orifice. Initial cost is lower. Maintenance cost is lower.

Write for complete information on this quality built nozzle and its large capacity strainer and adapter. Ask for Catalog 22 and Data Sheet 3997.

SPRAYING SYSTEMS CO.
3262 RANDOLPH STREET
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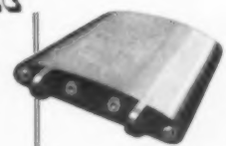
(Suburb of Chicago)

Delivered WHEN you want them
. . . and in the BEST quality*

COPPER



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side trimming and recoiling line for preparing coils for the electrolytic tinning line.

The hot dip tinning equipment will receive the product direct from the tin plate shearing line. Sheets will be fed from stacks, electrolytically pickled, coated with tin, cleaned, inspected, assorted, and packaged in one continuous operation. This hot dip tinning equipment has been designed to handle larger sizes of tin plate than has heretofore been handled on this type of equipment.

All equipment being furnished for Fairless works will be of the latest Aetna-Standard design and is designed for maximum production with a minimum of maintenance cost.

OPEN GEAR LUBRICATION

▲ A 90 per cent savings in the lubricant used on open gears was revealed recently at one of the country's leading steel mills.

A fluid type gear lubricant—Texaco's Crater 2X Fluid—provided the savings and at the same time permitted increased operating efficiency.

The lubricant is applied with a spray gun. Less lubricant is needed per application and fewer applications are demanded as compared with manual servicing and the use of ordinary lubricating compounds.

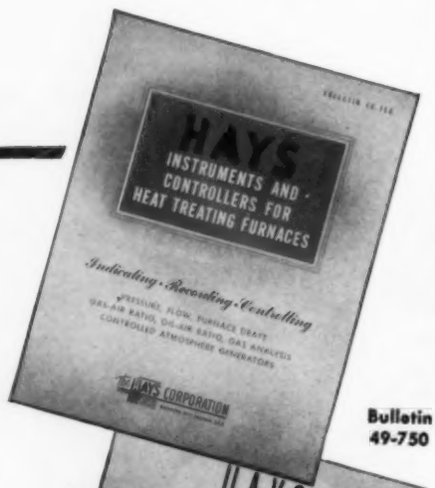
Experience has shown that with a gallon of this fluid an operator can lubricate all the open gears in his department without having to refill the container.

Bulletins on instruments and control for 2 types of furnaces

HEAT TREATING FURNACES

A complete summary of Hays products applicable to processes such as annealing, brazing and calorizing. Scope includes various methods of firing (underfired, overfired, sidefired), fuel burned (gas, coal, oil), and type of furnace (continuous, rotary hearth, slab heating, etc.).

Hays complete line of draft gages, flow gages, and meters (for high and low pressure gases and liquids), portable gas analyzers and automatic CO_2 recorders are covered.

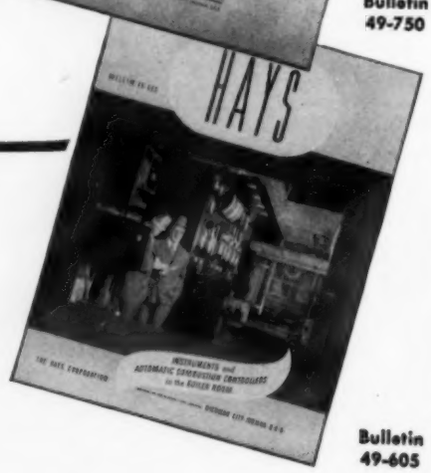

HAYS
INSTRUMENTS AND CONTROLLERS FOR HEAT TREATING FURNACES
Indicating · Recording · Controlling
THE HAYS CORPORATION

Bulletin 49-750

BOILER FURNACES

This bulletin summarizes applications of Hays centralized combustion control to chain grate, underfeed, spreader type, or lever type stokers; to attritia type, bowl type or ball bearing type pulverizers; to a wide range of oil burners including the rotary cup; and to a wide range of gas burners.

The Hays complete line of draft gages, flow gages, and meters (for high and low pressure gases and liquids), portable gas analyzers, automatic CO_2 recorders, and electronic type O_2 recorders are covered.



Bulletin 49-605

Write for these informative bulletins today.

THE **HAYS** CORPORATION

MICHIGAN CITY 13, INDIANA

combustion and industrial instruments and control

THERMAL RESISTORS

▲ Thermistors—thermally sensitive resistors are now in the engineering appraisal stage at Carboloy department, General Electric Co. The metal ceramics used for thermistors act in exactly the opposite manner to conventional metals as to electrical conductivity when temperature changes.

Not only does the electrical resistance of thermistors decrease with increase in temperature but the decrease is extremely sharp. One grade for instance, has a resistance of only a little over 1/100th ohm-inch at 600 F and a resistivity of 2000 ohm-inches at minus 50 F. A second material ranges from 1/10th ohm-inch at 600 F to 20,000 ohm-inches at minus 50 F.

The electrical resistance of these resistors decreases sharply with temperature decrease.

Small in size, thermistors because of their unusual non-ohmic characteristics may be used to replace highly intricate apparatus. Since they are pure electronic conductors, either d-c or a-c may be used.

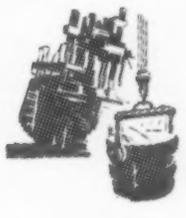
They appear to be especially adaptable as the sensitive elements in flow meters, liquid level indicators and controls, time delay relays, voltage regulators, vacuum gages, switching devices, and other types of indicators and controls.

...longer life
...like INTERNATIONAL GRAPHITE ELECTRODES

INTERNATIONAL Graphite & Electrode CORP.

A SPEER CARBON COMPANY SUBSIDIARY

ST. MARYS, PENNSYLVANIA

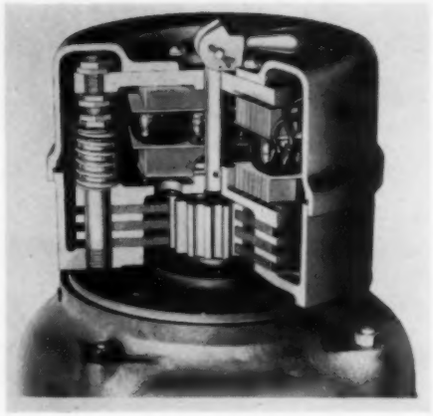


MAGNETIC BRAKES

▲ Dings Brakes, Inc., a subsidiary of Dings Magnetic Separator Co., announces the availability of a new line of a-c or d-c direct acting disc-type magnetic brakes.

The Dings brake, according to the manufacturer, is designed to stop any motor instantly, to hold the load, and to release with no drag. The brake is spring engaged and magnetically released and is designed to mount on Nema Type C motor flanges. Typically, the unit finds application on machine tools, hoists, cranes, elevators, screwdowns, etc.

Most prominent of the design features: the brake has no solenoids or mechanical linkages. Friction discs, springs and magnet constitute the heart of the unit. Very high thermal ratings are claimed for the brake. It is not necessary to dismantle the brake or disturb the torque setting in order to mount. A manual release lever, located outside the housing, is standard. Use of lever enables operator to disengage brake. This mechanism automatically resets itself, restores unit to usual operating condition when power is again applied. Torque and wear adjustment is made by adjusting a double set of lock nuts. Visual inspection of position of manual release lever indicates when adjustment is necessary.



These safety features are noted: in adjusting, it is impossible for the operator to increase the torque beyond the ability of the magnet to release. In addition, the shell of the housing shrouds the rotating discs, enabling the operator to make adjustment with safety while the unit is in operation.

Standard Dings units mount on horizontal motors but can be adapted for vertical mounting if so ordered. Brakes are fully enclosed, drip-proof and weather-proof. Special enclosures are also available. Leads on brakes can be connected to leads of either 220 or 440-volt motors.

CHROME CARBIDE

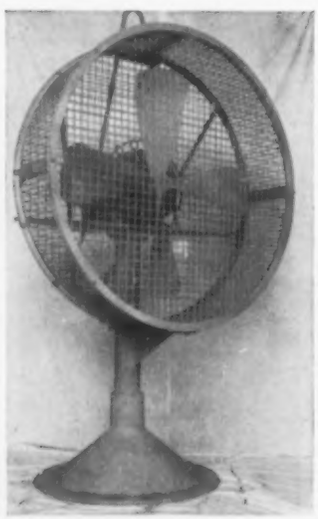
▲ Two high temperature resistant carbide metals were recently displayed for the first time by Carboloy department of General Electric Co., titanium carbide and Series 600 chrome carbide. Both are out of the research laboratory stage. Chrome carbide is at present in the "engineering appraisal" stage. Pilot-plant output is being used primarily for application development and appraisal at the present time. The chrome carbide is scheduled for quantity production in the near future.

The chrome carbide in all tests and experimental applications to date has shown a remarkable resistance to high temperature oxidation. Exposure for 24 hours at 1850 F in air—conditions under which conventional carbides and stainless steels disintegrate completely—leaves series 600 samples still with their metallic lustre and

IS HEAT SLOWING UP YOUR WORKMEN?

TRUFLO CRANE CAB FANS
For cooling interiors of crane cabs and other confined areas. Adjustable both horizontally and vertically. Four blade type, 12 and 18 in. sizes.

Keep them COOL with TRUFLO FANS



TRUFLO PORTABLE COOLING FANS
Easily portable. Help keep efficiency high where work is hottest. 12 to 36 inch diameters.

Production suffers when workmen are overheated. Steps begin to drag, efficiency falls.

Now, when speedy production is vital, Truflo Fans can help keep your workmen on their toes. All Truflo Fans are designed and built correctly to put fresh cool air *in large volumes* exactly where it is needed. Perfectly-balanced shafts and blades give more air per h.p. . . . strong steel frames stand up longer under hard use . . . rugged wire guards protect men against injuries.

All of the following types can help beat the heat, keep production moving in your plant. Write for illustrated literature.

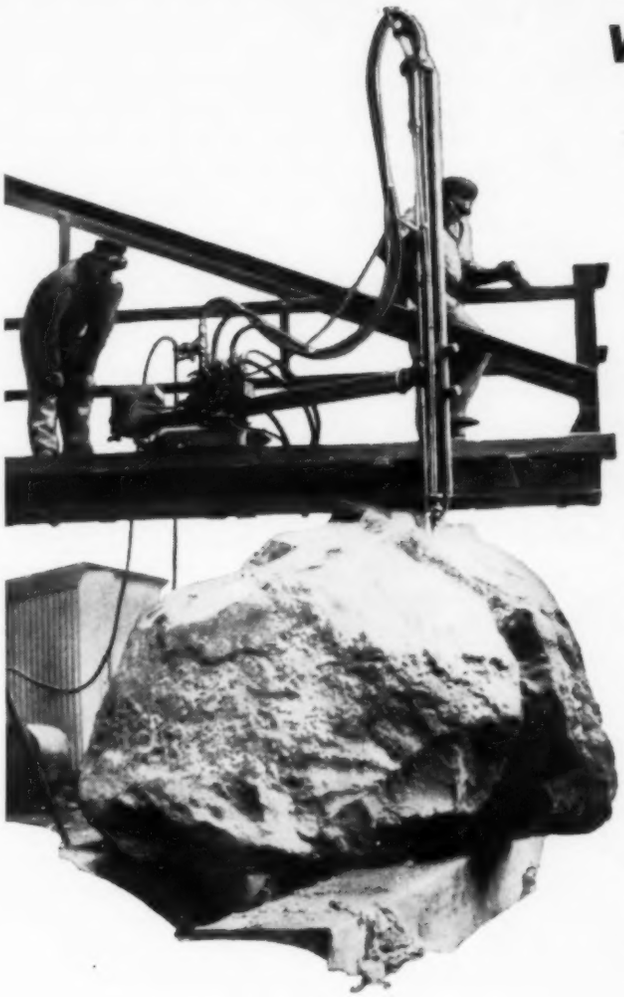
PORTABLE COOLING FANS
CRANE CAB FANS • WALL FANS
EXHAUST FANS • BLOWERS
ROOF VENTILATING FANS
PENT HOUSE FANS

TRUFLO FAN COMPANY
245 MAIN ST., HARMONY, PA.

Get in ALL Your Scrap---Profitably

with OXWELD Equipment

Trade-Mark



Here's the OXWELD *C-60 Cutting Blowpipe in action . . . slicing up a steel button 6 ft. thick with ease!*

Oxygen cutting rapidly converts steel sections of every size, shape, and type into good, usable scrap. Any thickness is easily reduced to charging-box size with OXWELD equipment. And no job is too tough. Whatever your scrap-cutting problem, there's an OXWELD blowpipe to solve it efficiently and economically.

For the extra-heavy jobs, the OXWELD C-60 Cutting Blowpipe with powder-cutting attachment is the answer. Especially engineered for cutting spills and ladle skulls, this combination easily makes continuous cuts through 6 ft. of dirty, slag-incrusted steel.

Other highly adaptable OXWELD blowpipes speed up medium scrapping operations. Mounted on portable, lightweight machines, they work on a production basis, cutting ingots, castings, and risers into sizes convenient for charging into the furnace.

On the lighter jobs, sturdy OXWELD hand-cutting blowpipes ready steel scrap up to 12 in. thick for the charging box. With 57 different nozzles to choose from, you get maximum efficiency at lowest overall cost.

LINDE has accumulated a vast amount of practical experience in helping to solve many unusual scrapping problems. If you have a scrap-cutting problem, ask our nearest office for help. We have the know-how, the "show-how," and everything you need to do the job profitably.

The term "Oxweld" is a registered trade-mark.

LINDE AIR PRODUCTS COMPANY

A Division of Union Carbide and Carbon Corporation

30 E. 42nd St., New York 17, N.Y. UCC Offices in Other Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

A lightweight OXWELD *portable machine speeds this scrap-cutting operation. Setup is semi-automatic and portable . . . can be easily moved from one job to another.*

Spills, salamanders, and other mill scrap can be cut quickly and efficiently with an OXWELD *hand-cutting blowpipe . . . and with minimum gas consumption.*

virtually no dimensional or weight change. Favorable results also have been obtained in other tests conducted at temperatures over 2000 F.

GEAR CARBURIZATION

▲ The development of a new gear-manufacturing process employing carburization, which limits distortion to one one-thousandth of an inch per foot of diameter, was announced recently by Brad Foote Gear Works, Inc. Carburization is a means of imparting hardness to gears through the application of heat.

Although carburization has long been recognized as a hardening method in the manufacture of gears, the new process is unique in that the heat treatment is controlled to an unprecedented extent. The accuracy of the heat regulation accounts for the fine tolerances achieved. It was pointed out that with the new process there are now some twenty-inch gears in production which distort less than 0.0015 of an in., while the distortion of identical gears manufactured by the old method varies from 0.015 to as much as 0.045 of an in.

Brad Foote's refinement of carburization, the result of years of extensive research hardens the meshing surfaces of the teeth in gears to a high degree while leaving the cores of the teeth soft but tough. The result is that a certain flexibility is realized, the advantage being that the impact on the teeth is reduced through absorption of some of the shock by the soft cores, he said. Accordingly the specially treated gears are longer wearing while the efficiency of machinery containing them is substantially improved.

"WELDABLE" CARBIDE

▲ The possibility of being able to "coat" metal parts with a relatively thin "skin" of ultra-hard, wear-resisting, tungsten carbide now appears possible. The Carboloy Department of General Electric Co. announced that it had completed basic laboratory development on a "weldable" tungsten carbide. It can be flowed onto metal surfaces, using conventional shielded electric arc welding equipment, available today in most of the larger and even many smaller metal working plants.

The new product is not as yet in production as a standard item but is in the "engineering appraisal" stage and undergoing field tests. It is made in experimental production at present in conventional welding rod form and sizes ranging from 1/16 to 1/4 in. diam.

When flowed on to a metallic surface such as steel or iron, it fuses and blends with the base metal and results in a surface coating containing approximately 70 per cent of wear-resisting tungsten carbide.

Welder is producing a wear-resistant tungsten carbide surface on a draw roll with conventional shielded arc welding equipment and a carbide welding rod.

MAKE FAST AND ACCURATE CUTS ON 10" TO 48" CAST IRON AND STEEL MAINS UNDER THE MOST DIFFICULT CONDITIONS

- Minimum Pipe Line down time.
- Cuts under water in flooded ditches.
- No broken pipe, milled cut.
- Thor Air-Powered, no flames near pipe.
- Set-up time about 15 minutes.
- Portable — weighs only 265 lbs. Two men can carry and set up unit.
- Small excavation — only 16" clearance needed.
- One machine cuts all pipe sizes from 10" to 48".
- Only two adjustments necessary for size changes.

Many tough pipe cuts must be made during construction, for emergency repairs and for maintenance. This one portable machine will handle all your pipe cuts from 10" diameter and up. You will not only save time and labor, but you will get tight joints because of the square milled cut. The Wachs Pipe Saw also cuts cement lined pipe and makes beveled cuts on steel pipe. This machine often pays for itself on a single job.

Write today for descriptive folder and engineering data on this new labor saving saw.

THE E. H. WACHS COMPANY
Manufacturers of Engines, Valves and Machinery since 1883
1525 NORTH DAYTON STREET · CHICAGO 22, ILLINOIS

MOVE up to 75,000 lb. COILS . . .

with less scrap, greater safety

Yield goes up . . . waste goes down . . . with LINK-BELT Coil Handling Equipment

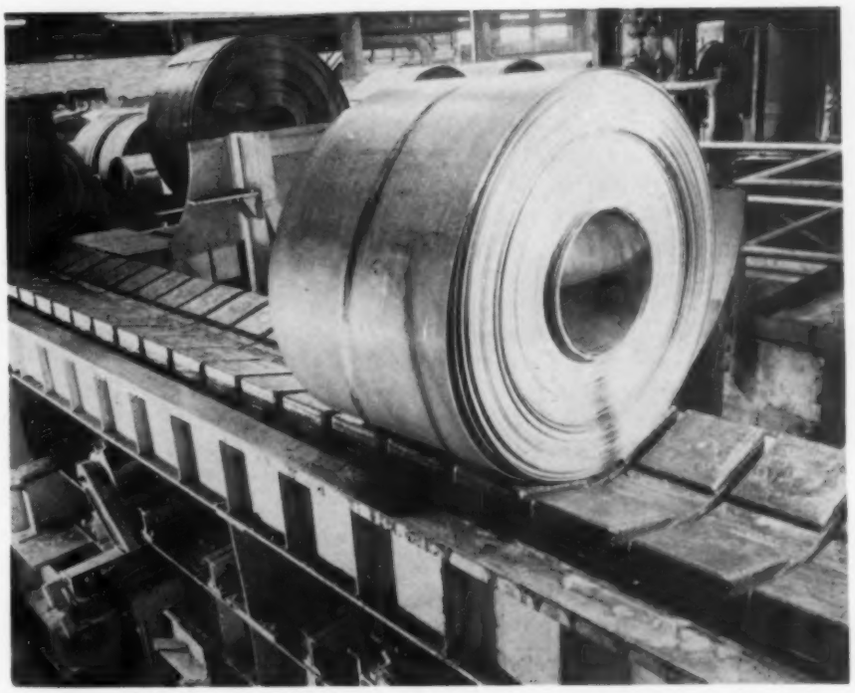
THE giant coils now handled in steel mills necessitate modern conveying equipment. Link-Belt has kept pace with new techniques, and today steel mills can move 75,000-pound pickled coils more easily than they once handled coils a fraction of that weight. From hot mill to shipping platform, three basic types of Link-Belt conveyors provide safe, economical transportation.

Link-Belt conveying systems eliminate hours of lost time. Coils travel close together, eliminating bottle-necks. They're handled gently, preventing edge damage. Down-time is reduced.

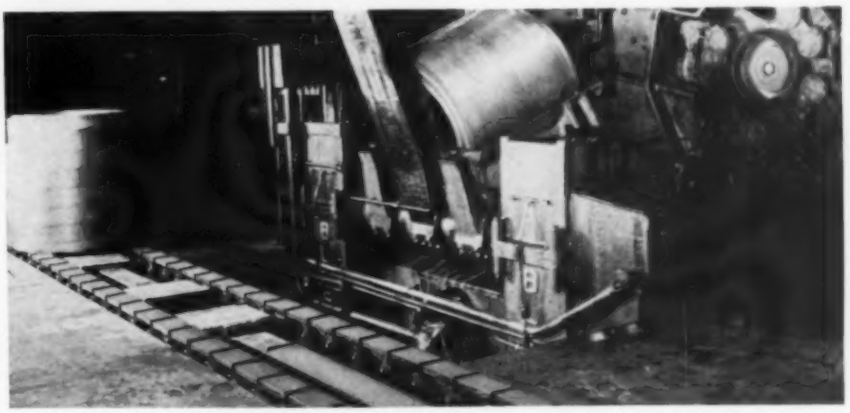
The physical work of crews is reduced. Link-Belt auxiliary devices transfer coils from one conveyor to another, turning, lowering, tilting, and weighing them with ease and precision. This increased mechanization means greater safety for workers.

It pays to call in Link-Belt while expansion is still in the planning stage. The Link-Belt engineer, working hand-in-hand with your own engineers, consultants and builders of mill and process equipment, can help you solve your mechanization problems.

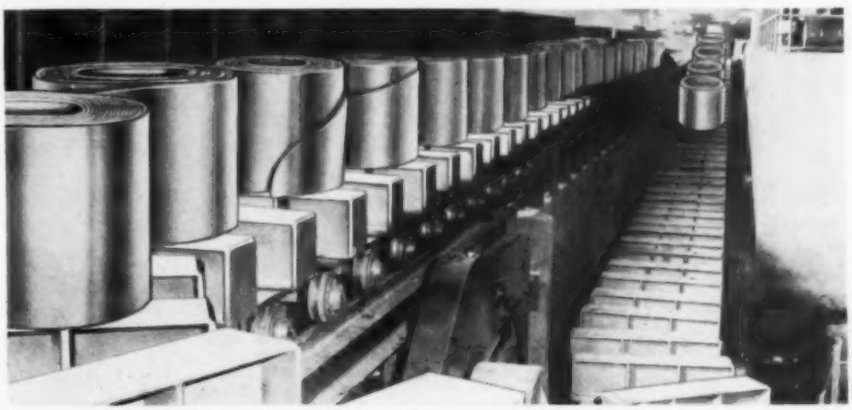
For a conveyor system planned to your specific requirements, contact your nearest Link-Belt representative.



Link-Belt V-top, 36-inch-wide heavy duty pallet conveyor at delivery end of continuous pickle line ahead of cold rolling mill, carrying 15-ton coils. Coils are carried on their sides without damage.



Link-Belt double-strand roller chain conveyor carries 76-inch coils from hot-strip coiler. Down-tilter lowers coil to Waffle-Top Loader. Other Link-Belt equipment transfers coils gently from one conveyor to another.



Where numerous turns are required or cooling space is limited, Link-Belt Car-Type Conveyors are best. Coil never leaves its car. Without rolling or scuffing of edges, coils go around corners, up and down inclines.

LINK-BELT

MATERIALS HANDLING, PROCESSING & POWER TRANSMISSION MACHINERY

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Cleveland 15, Pittsburgh 13, Atlanta, Dallas 1, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in principal cities. 12.418

Wear tests conducted so far indicate that such a surface has a wear-resisting ability of approximately 80 per cent that of "undiluted" tungsten carbide—and about 15 to 20 times that of the best chilled cast irons of 43 to 67 Rockwell. Data on the latter comparison was obtained using an aluminum oxide dry abrasion test.

The process of skin coating (1/16 to 1/4 in. thick skin) appears to be most suitable where it is desired to wear-proof parts for which the use of solid carbide sections is inconvenient.

Although most suitable where high surface finish of the coating is not essential, a surface coated with tungsten carbide in this manner can be ground or polished using conventional equipment as for solid tungsten carbide parts.

Several types of "binders" have been used to date in the experimental hard-surfacing-rods—including iron, nickel, and cobalt. No final determination has been made as yet as to the class of application for which each type of binder is best suited.

USE THE
ENGINEERING MART

MASTER SWITCH

▲ A redesigned master switch featuring a new cast-aluminum cover and up to five adjustable stops has been announced by the General Electric Co.'s control department.

For heavy-duty installations, the dustproof switch will find application on large materials handling equipment such as steel mill type cranes.

The new aluminum cover offers good protection for the switch interior from dust, dirt, and accidental blows, according to G-E engineers. Weighing only one-third as much as the previously used cast-iron cover, it is easy to remove for inspection and normal servicing of the switch interior.

Adjustable stops on the switch provide for any combination of from one to five points of movement of the operating handle in either clockwise or counterclockwise direction. An open end wrench is the only tool required to make this adjustment.

Standard equipment includes a ball and rod handle, but four other types of operations are also available: ball and rod handle with off-position latch operated from a thumb lever on the handle; ball and rod handle with auxiliary electrical switch operated from a thumb lever on the handle; ball and rod handle with spring return mechanism built into the handle; and an under-lever mechanism.

The new switch is fully interchangeable in size and mounting with former G-E types, and all wearing parts, such as contacts, springs, cams, etc. are the same, simplifying parts replacement.

Measuring 13-in. wide and 10-in. deep, it is approximately 14-in. high with the handle in a vertical position.

Revere ELECTRIC MFG. CO. CHICAGO, U.S.A.
LIGHTING for PLANT PROTECTION

Revere Lighting is productive lighting — it guards against costly losses by protecting every area of your plant. Insure safe handling in Crane yards with Floods and Area Lights. Prevent theft and pilfering with adequate Fence Lighting. Protect late shift workers with plenty of light at entrance and parking lots.

300 to 1500 Watt Eliptor Flood No. 3800

HIGH, MEDIUM, LOW BAY REFLECTORS

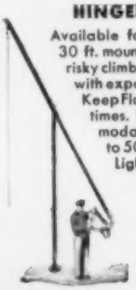
Give crane bays and shipping floors effective illumination. Ruggedly constructed for rough service. Superior, dust-shedding qualities. Equipped with REVERE exclusive KEY COLLAR, permitting easy installation or removal of reflector. For use with incandescent or mercury lamps.

AREA LIGHTER

Accommodates 300 - 500 watt regular or 750 - 1000 watt Bi-post Lamps. This low mounting unitis particularly effective for parking lots, entrance or yard areas where concentrated lighting is desired.

HINGED POLES

Available for 20, 24, and 30 ft. mounting. Eliminates risky climbing. Does away with expensive servicing. Keep Floods clean at all times. Built to accommodate up to 5-150 to 500 Watt Cluster Lights or 3-1500 Watt Floods.



WRITE FOR LITERATURE

180° FRESNEL FLOOD FOR FENCE LIGHTING

REVERE ELECTRIC MFG. CO.
6036 Broadway Chicago 40, Ill.

for Accurate PRESSURE REGULATION and TROUBLE-FREE SERVICE

Class AWG Reducing Valve

Accurate Regulation of pressures on machine tool, air and liquid lines is no problem with the Leslie AW Reducing Valve.

Trouble Free Service is assured from this fully self-contained, small, compact unit giving the following features:

★ CAST VIRGIN BRONZE BODY AND PARTS
★ OIL RESISTANT DIAPHRAGM AND VALVE INSERT
★ CORROSION RESISTANT SPRING
★ INTERCHANGEABLE REPLACEMENT PARTS
★ TOTALLY ENCLOSED—NO STUFFING BOXES
★ QUIET OPERATION
★ INLET PRESSURE RANGE 10-200 psi at 150° F.
★ REDUCED PRESSURE RANGE 5-75 psi

Class AWG is furnished with pressure gage at slight extra charge.

Dimensions and capacity data are included on Dwg 1223, available on request.

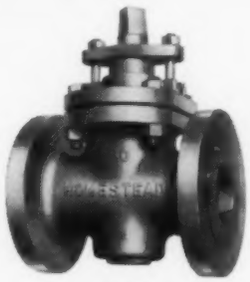
247 Grant Avenue, Lyndhurst, New Jersey

ESTABLISHED 1900 LESLIE CO.

PRESSURE REDUCING VALVES • PRESSURE CONTROLLERS
FLOATLESS LEVEL CONTROLS • PUMP GOVERNORS
TEMPERATURE REGULATORS • SELF CLEANING STRAINERS
AIR HORNS • STEAM WHISTLES

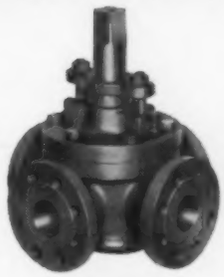
WE MAKE ALL TYPES OF PLUG VALVES
. . . including the right one for your needs

HOMESTEAD CAM-SEALD



Straight-way—
Flanged or Screw Ends

Three-way—Screw or Flanged Ends

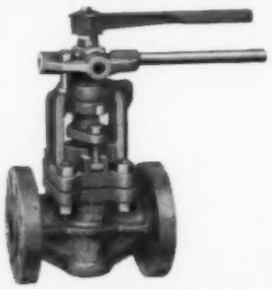


Four-way—Flanged or Screw Ends

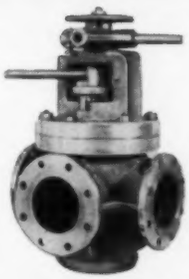
HOMESTEAD CAM-SEALD, QUARTER-TURN PLUG VALVES
(non-lubricated, or pressure-gun lubricated, as desired)

Available in metals for most valve needs; for pressures to 3,000 lbs.; temperatures to 750° F.

HOMESTEAD LEVER-SEALD



Straight-way—
Flanged or Screw Ends



Three-way—Flanged or Screw Ends

Four-way—Flanged or Screw Ends

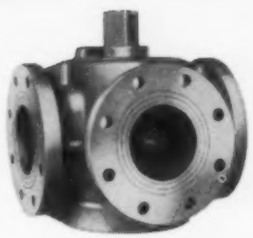
HOMESTEAD LEVER-SEALD, QUARTER-TURN PLUG VALVES
(non-lubricated, or pressure-gun lubricated, as desired)

Made in combinations of metals and alloys to meet practically any service requirement; from 1½" to 10"; from vacuum to 1,500 pounds.

HOMESTEAD-REISER

Straight-way—
Screw or Flanged Ends

Straight-way—
Worm & Gear Operated



Flow-Changer—Non-lubricated

HOMESTEAD-REISER SELF-SEALD LUBRICATED PLUG VALVES
(100% Port Area, or Venturi, as desired)

Available in semi-steel; cast steel; sizes ½" to 12" for steam pressures to 150 lbs.; oil-water-gas to 200 pounds.

We are the only manufacturer who makes *all* of the various types of plug valves used in industry . . . LUBRICATED . . . NON-LUBRICATED . . . FULL PORT . . . VENTURI. We have no "leaders." *We make them all;* therefore, we have no reason to "push" one type valve over another. Our only concern is to see that you get the *right* valve for *your* requirement.

To help you keep this in mind the next time you need plug valves, we'd like to send you our catalog. Why not write for it today.

HOMESTEAD VALVE MANUFACTURING COMPANY
P. O. BOX 21 **CORAOPOLIS, PA.**

Serving since 1892

Book Reviews . . .

▲ **"Industrial Furnaces, Vol. I,"** by W. Trinks has just been issued in a new and revised fourth edition, 6 × 9 in., 526 pp, price $10.00. Publication has been done by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. The original edition covers all phases and problems of practical furnace design. The fourth edition brings the book up to date by including the latest scientific developments which research has revealed on heat transfer and furnace design, and also includes the latest in present day practice. About 40 per cent of the third edition has been completely rewritten. There is perhaps no better book available for the steel plant combustion or furnace engineer.

▲ **"NEMA Standards for Brushes for Electrical Machines, Publication No. CB1-1951,"** has just been issued by NEMA, 155 East 44th St., New York 17, N. Y. These standards have been approved both by NEMA and by the American Standards Association, Inc. They cover carbon, graphite, electrographitic and metal-graphite brushes used in the electrical manufacturing industry. Definitions, accompanied by illustrations, are included for the various types and classifications of brushes, brush connections and brush clips. The dimensions, tolerances and test procedures are given in some detail. ($1.50 per copy.)

▲ **"New Lessons in Arc Welding"** was recently issued by the Lincoln Electric Co., 12818 Coit Rd., Cleveland, Ohio, 312 pp, 5⅝ × 8½ in., price $1.00 in the United States. This book is a revision of the well known lessons in arc welding which had previously appeared in three editions and consists of an enlargement of the previous book by the addition of a series of lessons which form the basis of instruction in the Lincoln Arc Welding School. The lessons for both types of courses given in the Lincoln School, namely the basic course in the fundamentals of arc welding and the advanced courses in alloy welding, sheet metal welding and pipe welding are included in the book. The book also includes a welding application supplement which gives new procedure data and supplementary information for the best ways to use welding.

▲ **"Magnetic Materials"** by F. Brailsford, which was recently published in Great Britain may be obtained from John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. This book consists of 156 pages, 4 × 6½ in., price $1.50. This book forms one of a series of monographs on physical subjects published by Methuen & Co., Ltd., London, England. The book includes our present knowledge of magnetic materials in a relatively brief volume. It also includes a number of applications used in industry.

▲ **"Theory of Perfectly Plastic Solids"** by William Prager and Philip G. Hodge, Jr. has recently been issued by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 264 pp, 6 × 9 in., price $5.50. The book is not an exhaustive treatise on the general theory of plastics, but is the first to be written on an intermediate level on the theory of perfectly plastic solids. The book is one in the Applied Mathematics Series published by John Wiley & Sons, Inc., and as such is primarily theoretical and mathematical.

(*Please turn to page 198*)

BROWNING
MILL TYPE CRANES have
Plenty of Strength WHERE
STRENGTH IS NEEDED!

Browning Mill Type Cranes are built in accordance with A. I. S. E. specifications. They incorporate the types of motors and controls on which your mill or industry has standardized. This flexibility adapts your VRB crane *perfectly* to your needs. Only the finest materials are employed. Browning heavy duty cranes meet the most rigid demands and satisfy the most critical users. Our design, placing plenty of strength wherever needed, is the outgrowth of 48 years' experience in the crane industry.

"Built as you yourself would build them"

Write fo · our Eulletin "E".

VRB

VICTOR R. BROWNING & COMPANY, Inc.
BOX 309, WILLOUGHBY (CLEVELAND), OHIO
Designers and Builders of Electric Overhead Traveling Cranes and Hoists and Electric Revolving Cranes

RED CIRCLE Rolls ALLOY-CHILLED

CHILLED and ALLOY IRON ROLLS

Rolling Mill Machinery

GRAY IRON CASTINGS

HYDE PARK FOUNDRY & MACHINE CO.
HYDE PARK, PA. (PITTSBURGH DISTRICT)

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... any of the bulletins reviewed in the Publication Service of the IRON AND STEEL ENGINEER without obligation or cost. Simply circle the desired item numbers on one of the prepaid postal cards and mail. The requests will be forwarded to the manufacturers involved who will send the bulletins to you.

(1) Electroplating of Steel

Publication has been announced of a 28-page illustrated booklet, "Four Good Steps Toward Better Electroplating on Steel," giving specific recommendations for effecting improvements in the average cycle for cleaning steel before electroplating. The booklet lists in detail the benefits to be gained by: (1) precleaning more thoroughly—because the electrocleaning tank operates more economically and more effectively when the heavy oils and greases are removed by precleaning; (2) rinsing more thoroughly—because inadequate rinsing is the recognized cause of a large portion of plating difficulties; (3) using reverse current cleaning for all electrocleaning of steel—because it does a more thorough job of removing a variety of films that are unfavorable to the adhesion of electrodeposited metals; and (4) using an efficient electrocleaner that provides high conductivity, superior smut removal, long solution life and other advantages. (F5867R1). Oakite Products, Inc.

(2) Electric Contact Controllers

A 16-page catalog is available illustrating and describing vane type electric contact control units used with "Electr-O-Vane" thermometers and pressure gauges, and with the "ElectroniK" potentiometer, as well as those employed in the new "Pyr-O-Vane" and "Protect-O-Vane" millivoltmeters, to give snap-action on-off, two position or three position control. (8000). Brown Instruments Division, Minneapolis-Honeywell Regulator Co.

(3) Engineered Lighting

A new catalog, 64 pages of pertinent information regarding specific lighting units designed and engineered for specific purposes, is ready for distribution. This bulletin contains 90 product illustrations, 75 cross-sectional drawings and 59 candlepower distribution curves, giving detailed information on a total of 270 lighting units. Special emphasis is given to the description, performance, application and installation as well as to the dimensional data of this equipment. This catalog is an up-to-date reference book for the latest in lighting equipment. A combined engineering data book and catalog, this publication is available upon request as a complete guide to all persons charged with the responsibility for better lighting. Holophane Co., Inc.

(4) Characteristics of Measuring Circuits

A bulletin is available that discusses the characteristics of the measuring circuits used in the "ElectroniK" potentiometer. It is the second of a series for the benefit of those who wish to apply and utilize this versatile instrument to unique or specialized measurements frequently encountered in scientific and technical investigations. (B15-13). Brown Instruments Division, Minneapolis-Honeywell Regulator Co.

(5) Cost Cutting Materials Handling

A 24-page booklet titled "The How Book of Cost Cutting Materials Handling" is now available. A revised edition of a previous booklet printed in 1947, the "How Book" was prepared under the guidance of Dr. V. S. Karabasz, Professor of Industrial Management, Wharton School, University of Pennsylvania. A large portion of the "How Book" is concerned with basic background material covering types of skids, pallets and other industrial handling tools. Most of the balance covers a comprehensive plan for evaluating present handling methods through an engineering analysis much like a time and motion study. Enclosed in the book are several charts and summary sheets for making a materials handling analysis. More sheets are available. (P-902 Rev). Yale & Towne Manufacturing Co.

(6) Fusion Welding of Nickel

A new, 44-page booklet on the fusion welding of nickel and the high nickel alloys has just been published. It contains 44 pages and includes more than 30 tables and almost 50 drawings and photographic illustrations. A complete technical treatise on the subject, it covers various forms of electric arc welding as well as gas welding. There are over 20 chapters and sections covering, in addition to detailed welding instructions, such information of importance to production and welding engineers as the boiler code of the American Society of Mechanical Engineers, pickling, testing and inspection safety methods and associated topics. (Technical Bulletin T-2). International Nickel Co.

(7) Engineering Properties of "Ni-Resist"

A 36-page bulletin describing eight types of austenitic nickel alloy cast irons that offer unique combinations of properties is available. Applications and comparative service data in many industrial fields are presented to prove its utility in withstanding corrosion, heat, wear and low temperature. High or low controlled expansion, magnetic or non-magnetic properties and resistance to thermal shock add variety to its usefulness. A reference booklet, it is well illustrated with photographs, tables of properties and corrosion data on nearly 400 conditions. (EZ). International Nickel Co., Inc.

(8) Metallic Rectifiers

A new booklet on metallic rectifier power conversion units has been announced as available. The bulletin describes the features of the equipment, its application and operation. It is illustrated with photographs, line drawings and charts showing efficiency and regulation curves for the various sized units. A specification guide for General Electric d-c power supplies and exciters is also included, as well as complete rating charts and dimensions. (GEA 5658). General Electric Co.

(9) Synchronous Motors

Standard construction features of low speed, coupled-type, pedestal-bearing synchronous motors are described in a new bulletin just released. The features described are available in these pedestal-bearing synchronous motors in ratings approximately 100 hp and larger at speeds of 450 rpm or less. Motors of 1.0 power factor or 0.8 or better leading power factor are available. (05B7648). Allis-Chalmers Manufacturing Co.

(10) Cast Alloy Tools

Machinists, metallurgists, and tool designers will find much useful data on cast alloy metal-cutting tools in a new 44-page tool manual and catalog just published. The booklet describes four different grades of cast cutting tool alloys. It gives the physical, mechanical, and chemical properties of these alloys to help in selecting the right tool alloy for various cutting operations. A brief general description of chip formation and tool design, and their effects on tool life, is also included. Among the 80 illustrations and tables in the booklet are tables giving proper cutting angles, speeds, feeds, and depths of cut for turning, boring, and milling. Cutting speeds are based on the relative machinability of various commonly machined materials. One table gives ratings for over 60 alloys and alloy steels. Methods for grinding tools and brazing tipped tools are also discussed (F-7883). Haynes Stellite Co., a Division of Union Carbide and Carbon Corp.

(11) Flow Signal Transmitter

The Hagan flow signal transmitter, recently announced, is described in a new bulletin. This pneumatically operated pressure-differential measuring unit transmits proportional signals to remote recording or indicating instruments, or to automatic control elements. The signals may be linear with flow or linear with pressure differential. Diagrams in the bulletin illustrate seven suggested uses of the transmitter in measurement of flow, liquid fuel, liquid level, and absolute pressure. Flow applications include measurement of steam output from a boiler, superheater or evaporator; of feedwater flow to a boiler; of liquid flow through pump units; and of gas, vapor or liquid flow in process systems. A cutaway drawing in color illustrates the principles of operation. Other plates show the various types of differential measuring elements and illustrate the use of a dead weight checking attachment for reference calibration of the transmitter under full static pressure. (2551). Hagan Corp.

(12) Magnets

A 12-page catalog briefly describing an entire line of magnetic separators and lifting magnets has just been released. The illustrated bulletin tells which magnets to use to remove iron from wet or dry materials carried on conveyor belts, as well as from chutes, ducts, etc. Units for magnetic concentration and purification, heavy media recovery and materials handling are also completely described. Bulletin serves as a guide to the selection of a magnet from the application standpoint. (C-5000-B). Dings Magnetic Separator Co.

(13) Industrial Trucks

Just released is a new condensed general catalog on industrial trucks. The 12-page, 2-color brochure is divided into four sections covering high lift and low lift platform trucks, fork trucks and mobile cranes. It lists capacities and dimensional specifications on each class of truck manufactured by the company, and gives a brief description of major construction features. Several materials handling ideas are also presented in picture form. Elwell-Parker Electric Co.

(14) Crane Cab Conditioners

A 16-page bulletin is available that contains a description of the features of design found only in "Aire-Rectifiers"; temperature tables and recommended sizes of conditioning units for all ambient temperatures found in mill and foundry. It tells how crane cab conditioning differs from general air conditioning; how to determine whether the machines offered have required capacity to handle the heat load expected; and the three models of "Aire-Rectifiers." Lintern Corp.

(15) Servicing "Sulphated" Batteries

Data sheets are available telling how to return to full service motive power storage batteries which have lost capacity due to "sulphation." Sulphation is the formation of lead sulphate on the positive and negative plates due to continued undercharging while in use, or prolonged idleness without charge. The sheets give 6 causes of sulphation and detail 11 steps to follow to restore batteries having various degrees of sulphation—from early development stages to the point where the battery must be scrapped. Gould-National Batteries, Inc.

(16) Plugs and Receptacles

A new bulletin is available on a circuit breaking series of plugs and receptacles, trade name "QuelArc." This bulletin describes in detail and illustrates all the unique safety and durability construction features of these heavy duty connectors for portable electrical equipment from 20 to 200 ampere ratings. Sizes and styles are tabulated for easy reference and specification. Typical circuit diagrams are included. (602). Pyle-National Co.

(17) Digest of Motor Controls

Just released is a new edition of "Controlog," a digest of motor controls. This 88-page illustrated book contains essential information on the complete line of a-c and d-c motor starters, motor control centers, contactors, relays and other accessories. Included are open and closed views of the more popular items, general descriptions, applications, enclosures, outline dimensions, catalog numbers and list prices. The contents of the book are arranged for convenience and speed in referring to desired information. A numerical index on page 1, correlated to a marginal indexing system on each page, further simplifies the locating of any specific item among the thousands of models covered in this handy reference book. Clark Controller Co.

(18) Caustic Soda

Just issued is a new caustic soda bulletin prepared for all users of this important basic chemical. Divided into four sections under tabbed headings, the booklet provides handy reference for particular problems on purchasing, handling and storage, equipment design and technical data. Purchasing departments will find the comparison of various forms of caustic soda and the evaluation of shipping and ordering points helpful in selecting the form of this chemical most economical for use at their plants. The section on equipment design has been especially prepared to deal with the problems of engineering, construction and maintenance personnel. Charts and tables showing freezing point, specific gravity at various temperatures, NaOH content and density and other properties of caustic soda have been designed to give technicians and chemists readily-available answers to their particular questions. A separate leaflet covering instructions for safe handling of caustic soda tank cars is inserted in the flyleaf of the main bulletin. Detailed instructions for steaming and unloading 50 per cent and 72 per cent caustic soda, as well as general information and personal precautions are included. (H-570). Pennsylvania Salt Manufacturing Co.

(19) Push-Lock Plugs

A bulletin is available that illustrates and describes push-lock type plugs for portable feeder cables to welding machines. Specially designed for welding needs these plugs are reported to be easily engaged yet almost impossible to disconnect accidentally. Molded as one-piece neoprene rubber units they are available molded-to-cable lengths of customers specifications or in the newly developed attachable type. According to the manufacturer they won't crack or shatter and can't become out-of-round. (SM-2). Joy Manufacturing Co., Electrical Connector Division.

(20) Tensiometer Announced

A new 8-page, two-color bulletin on the G-E tensiometer, a device for continuous tension indication of cold-rolled strip in steel, brass, and aluminum mills, has been announced as available. Illustrated with photographs and diagrams, the new bulletin describes the mechanical and electrical operation of the tensiometer, its possible applications, and recommended auxiliary equipment. (GEA-5512). General Electric Co.

(21) Solenoid Valves

A new catalog describes solenoid valves for dependable shut-off on oil pressures up to 300 psi heavy grades as well as light fuel oils, oil temperatures up to 250 F and both UL and FM approval. A rotating cam feature provides a shearing and wiping action to clear away any foreign particles in the oil and ensure shut-off of oil without leakage. (710). Hauck Manufacturing Co.

(22) Heat-Setting Cement

A bulletin describing "Vega Bond," a super-duty silica cement for use in laying silica refractories, has been published. This heat-setting cement corresponds in refractoriness and in chemical and physical properties with the best silica brick, and is recommended for poured or trammeled joints. The cement does not soften in service, even at a temperature as high as 3000 F. In addition to descriptive material, the bulletin includes a series of photographs which show the results of comparison tests between "Vega Bond" and other silica cements. Among the properties illustrated are comparative effects of heat treatment, refractoriness, trowelling and settling. Harbison-Walker Refractories Co.

(23) Industrial Truck Maintenance

The "Care and Maintenance of Industrial Trucks," important in protecting your investment and assuring continuity of service, is the subject of a manual just published. In the interest of more efficient, more continuous and more economical service from industrial trucks, this 16-page bulletin contains 51 illustrations of the steps to be taken in preventive maintenance and annual check-ups. Because of the high current labor rate and the scarcity of good skilled labor, major overhaul jobs should be kept to a minimum. With the mounting costs of essential wearing items, these materials should be conserved as much as possible. It is just plain common sense to make the substantial savings that truck preventive maintenance affords and this manual tells how. Baker Industrial Truck division of Baker-Raulang Co.

(24) Pickling and Plating

A new volume of "Heiline News" has just been published and is available for circulation to interested parties within the steel industry. Photographs and descriptions in the current issue relate directly to acid-proof equipment used in pickling and plating operations as carried on in a steel or wire mill. These photographs portray very completely the facilities of this company for fabrication and lining of acid-proof equipment as well as the varied applications of Heil steam jet agitators. (Vol III, No. 2). Heil Process Equipment Corp.

(25) Reciprocating Pump

Just released is a data sheet 67-A, describing the new Aldrich 6-in. stroke direct flow pump series. The 8-page bulletin gives full details of design and construction including dimension and sectional drawings, performance data and pump specifications. These 6-in. stroke direct flow pumps can be used on descaling systems and hydraulic systems in the steel industry. (67-A). Aldrich Pump Co.

(26) Foundation Construction

A booklet is available describing the Franki displacement caisson method of foundation construction. The booklet tells why this method is the safest and most economical way to build foundations. Franki Foundation Co.

(27) Blowers and Compressors

A bulletin is available describing centrifugal blowers and compressors. The types described are multistage; single stage, end suction and single stage double suction. The information in the bulletin is arranged in four major sections, including application data, design and construction, drives, and engineering data. This book is quite complete and should be in the hands of all users of centrifugal blowers and compressors. (0500). De Laval Steam Turbine Co.

(28) Synclinal Filter

A bulletin is available on the Marvel synclinal filter, which is a sump type liquid filter. This bulletin tells how this filter keeps hydraulically equipped machines operating with clean oil. Included in this bulletin is engineering data on the various type filters, as well as charts and dimensions pertinent to their use. (105). Marvel Engineering Co.

(29) Coal Preparation Plants

A booklet is available describing the facilities of a company that builds coal preparation plants. This firm has been in the coal and railroad field for many years, and is now expanding to include the steel industry field. The booklet shows various installations made by this company and gives some background information to confirm it. Roberts and Schaefer Co.

(30) The Silicone Story

A booklet is available telling the story of silicones, the most promising group of chemical products introduced to industry in many years. What they are, what they can do and have done, and how you may profit through the use of silicones is told in this book in terms of silicone's four basic properties. Chemical Dept., General Electric Co.

(31) Long Flame Burners

A new booklet is available describing small capacity, long flame burners for gas, for oil, and for gas and oil. The bulletin describes the principle of operation of these burners and also includes information on the various types of burners for various applications. It is complete with charts and dimensions. (1220). Bloom Engineering Co., Inc.

(32) Steel Mill Rolls

A booklet is available describing how Ohio Steel Foundry Co. manufactures rolls and other structural shapes. The booklet was prepared after a life-long purchaser of rolls visited this plant and showed astonishment at the involved production procedure in making what he had always thought of as "just cylindrical pieces of steel or iron." He soon learned that if rolls are to stand the gaff, they must be more than that. The new booklet tells how a team of specialists, working as a closely knit unit, and not as individuals, supervises and directs the complicated production of rolls. The continued vigilance of this coordinated talent brings you better rolls faster. At Ohio Steel, this is called integrated process control. It is a book that should interest all users of steel mill rolls. (451-R). Ohio Steel Foundry Co.

(33) Electric Brush Holders

A book is available describing the Flower brush holder. The book tells how brush holders, an integral part of electrical equipment, is well designed to provide long life and low maintenance cost. The long life is built into the unit by the use of wrought "Everdur" or brass in making boxes of Flower brush holders. The toughness and denseness of this material resists vibration and wear and causes the accurate dimensions of the box interiors to persist for long periods of time. Every electrical department should have a copy of this very complete book on electric brush holders. D. B. Flower Manufacturing Co.

(34) Mill Accessory Equipment

A 52-page booklet on mill accessory equipment is being prepared and will soon be published. You can reserve your copy of this booklet now by indicating your desire on the postal card below. This new booklet will describe a complete range of mill accessory equipment for steel, brass and aluminum mills. E. W. Bliss Co.

(35) Gear and Bearing Lubrication

Two booklets are available to you. The first describes "Macoma" oils for enclosed gears. It tells how these oils solve the problem of extreme pressure lubrication with seven advantages. The second booklet describes "Alvania" EP grease for grease lubricated bearings. It tells how this grease serves all grease applications in the majority of plants. In rolling operations, for example, mill operators report that this grease film just won't be ruptured, regardless of shock rolling load. Shell Oil Co.

(36) Air Catalog

Just published is a 16-page, condensed catalog describing equipment for air conditioning, for air handling, and for air cleaning. Under air conditioning equipment will be found: unit air conditioners, unit heaters, hermetically sealed compressors, and condensers and water coolers. What the equipment consists of, its features, and its specifications are included. The air handling apparatus section includes: ventilating equipment, air conditioning equipment, heating equipment, general purpose and industrial fans, and heavy duty and mechanical draft fans. Specifications and capacity data are in considerable detail. The third and final section—the electronic air cleaning equipment section—includes: Precipitron—principle of operation, home air cleaners, horizontal air cleaner, vertical air cleaner, and oil mist control unit. The how-it-works and how-to-use-it information is in usable form. (B-5164). Sturtevant Division, Westinghouse Electric Corp.

(37) Visual Planning

A new 80-page catalog on visual planning is available. This catalog contains the "Whys" of 3-dimensional planning, explains the functions and advantages of such planning in full detail, outlines and illustrates the "Repro-Templet" system of producing reproduction prints. In addition, it has an itemized list of over 6000 standard stock items—machine-tools, material-handling equipment, shop equipment, and office-planning equipment. Visual Planning Equipment Co.

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61	ELECTRIC PRODUCTS CO.	BULLETIN 2-200	Tells about custom-engineered a-c and d-c motors and generators, induction motors, battery chargers, frequency changers.
62	ELECTRIC SERVICE MANUFACTURING CO.		Illustrated folder obtainable on Keystone electrical products.
63	FARVAL CORP.	BULLETIN 60	Illustrative diagrams and installation data available on the Farval spray valve.
64	GENERAL ELECTRIC CO.	BULLETIN GEA-5408	Explains G-E crane drives.
65	GULF OIL CORP.		Pamphlet available on Gulf rust preventives.
66	HARNISCHFEGER CORP.	BULLETIN C-42	Describes P&H mill type cranes.
67	HAYS CORP.	BULLETIN 49-750 BULLETIN 49-605	Gives information on heat treating furnaces. Describes boiler furnaces.
68	KOPPERS CO., INC., FAST'S COUPLING DEPT.		Fast's catalog available giving detailed descriptions, engineering drawings and photographs.
69	OAKITE PRODUCTS, INC.	FOLDER F7993	Tells how a new metal cleaner removes oil and rust in one operation.
70	OKONITE CO.	BULLETIN IS-1053	Gives the facts on Okonite wires and cables.
71	PACIFIC PUMPS, INC.	BULLETIN 109	Describes Pacific's precision built pumps.
72	PITTSBURGH LECTROMELT FURNACE CORP.	CATALOG 8	Gives the whole story on what Lectromelt can do for production.
73	POOLE FOUNDRY AND MACHINE CO.		Catalog obtainable on flexible couplings
74	POST-GLOVER ELECTRIC CO.	BULLETIN 500	Gives complete data on Post-Glover nonbreakable steel grid resistors.
75	PYLE-NATIONAL CO.	BULLETIN 1150	Tells about Pyle-National's safety switches and circuit breakers.
76	STEARNS MAGNETIC, INC.		Bulletin gives complete specifications and operating data on Stearns lifting magnets.
77	TIDE WATER ASSOCIATED OIL CO.		Bulletin available on "Tide Water Associated Lubricania."
78	WACHS CO., E. H.		Descriptive folder and engineering data available on the Wachs pipe saw.
79	WAGNER ELECTRIC CORP.		Bulletins obtainable giving full information on the complete line of Wagner motors.
80	WALDRON CORP., JOHN		Folder available explaining coupling features which give added insurance against coupling failure.
81	WESTINGHOUSE ELECTRIC CORP.	BOOKLET B-4730	Gives the facts on Westinghouse Series 600 mill motor.
82	YALE AND TOWNE MANUFACTURING CO.		Catalog available on Yale worksaver trucks.
83	YODER CO.		86-page illustrated book on cold roll forming is available.
84	YORK ENGINEERING AND CONSTRUCTION CO.		Circular available on greater efficiency in plant construction and engineering.

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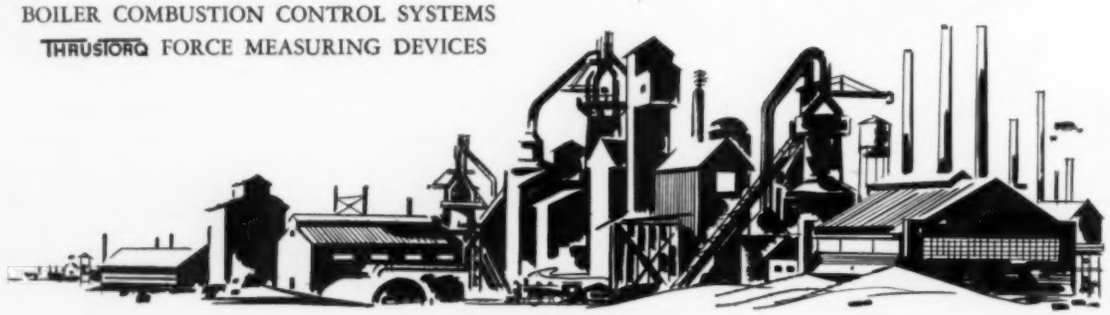

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Book Reviews . . .

(*Continued from page 188*)

▲ **"Techniques of Plant Maintenance in 1951"** has been recently published by Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y., 8½ × 11 in., 223 pp, price $6.00. This book covers the technical sessions and discussions which were held at the Second Plant Maintenance show in Cleveland, Ohio in January 1951.

▲ **"NEMA Standards for Unit Substations, Publication No. 201-1951 to 205-1951"** covers integral primary unit substations and radial-type, primary-network-type, spot-network-type, low-voltage selective-type and duplex-type articulated primary unit substations. Specific information is given concerning general arrangement, ratings, incoming section, transforming section, outgoing section and additional and alternate standard equipments. One-line diagrams illustrate typical substation units, and the different types of units are defined. ($3.00 per copy).

▲ **"The Structure and Mechanical Properties of Metals"** by Bruce Chalmers has been recently published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 5½ × 8½ in., 102 pp, price $3.50. This is the second volume in a series of monographs on metallic materials published under the authority of the Royal Aeronautical Society. This book provides a simple possible picture of metal and alloy structure and develops from this how mechanical properties depend on the structure. The theory is simplified and the author avoids the use of mathematics in the development of his book.

▲ **"Industrial Wastes"** by Charles H. Lipsett, has been printed by the Atlas Publishing Co., Inc., 425 West 25th St., New York 1, N. Y., 6 × 9 in., 317 pp, price $5.00. The book is a comprehensive survey of the economic function and collection of important industrial waste materials in our industrial economy. The book describes many technical recovery processes, methods of collection and marketing procedure for wastes in the plastics, metals, chemicals, textiles, steel, glass, wood, rubber, paper and other industries. This is not a pollution or waste treatment book, but emphasizes conservation and utilization, and as such, is probably the first of its type.

▲ **"Guide to Foreign Sources of Metallurgical Literature"** by John Milek, was recently published by Richard Rimbach Associates, 921 Ridge Ave., Pittsburgh 12, Pa., paper bound, 8½ × 11 in., 95 pp, price $2.50. This book is of particular value to the research worker, and provides a listing of the various types of foreign periodicals, abstracts, bibliographies, reports and books listed by subject. It may be of interest to the metallurgist or student interested in metal production.

▲ **"Warmetechnische Rechnungen fur Industrieofen (Thermal Calculations for Industrial Furnaces), third edition,"** by Werner Heiligenstaedt, 488 pages, 6¼ × 9 in., 152 illustrations, and 165 tables. Verlag Stahleisen, Dusseldorf. 44 german marks, (about $10.00).

This book emphasizes fuel economy and shows how to attain it. Heiligenstaedt limits himself to fuel-fired furnaces, and electrically heated furnaces are not included. The calculations are almost entirely restricted to fuels which are readily available in Germany, thus, natural gas and fuel oil are practically excluded. The first part of the book deals with the nature of heat, with calorific value of fuels, combustion, heat content of products of combustion, efficiency of heat utilization, and with fuel saving by preheating air and fuel.

The next section describes detailed steps in the production of steel and commodities made therefrom, the making of cast iron, malleable iron, alumina, copper, nickel, aluminum, magnesium, bricks, earthenware, glass, cement, and of various chemical substances. Then follows a section on specific heats, reaction heats, and useful heat required by the various processes. Speed of combustion and its effect on burner design follow. Much space is given to heat transfer and to conduction of heat; from both, wall losses are computed for continuous operation and for intermittent operation. A large section is devoted to heating capacity and fuel economy of furnaces of many types including batch type furnaces and continuous furnaces for heating solid material, open hearth furnaces, blast furnaces, and blast furnace stoves. This subdivision includes the Krupp process for making sponge iron.

According to word received by the reviewer, a translation is now being made in England. (Reviewed by W. Trinks).

▲ **" Phase Transformations in Solids,"** has been published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. This book contains 660 pp., 5½ × 8½ in., price $9.50. This book covers a symposium held at Cornell University and sponsored by the Committee on Solids, Division of Physical Science, National Research Council. It was prepared by an editorial committee sponsored by R. Smoluchowski, chairman. The book is of interest to scientists in many fields, but is of particular interest to metallurgists.

▲ A new volume of the **"Minerals Yearbook,"** a basic source of information on domestic and foreign mineral commodities, published annually by the Bureau of Mines, is now available for distribution. Bound copies of the 1949 Minerals Yearbook may be obtained only from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. for $4.50 each.

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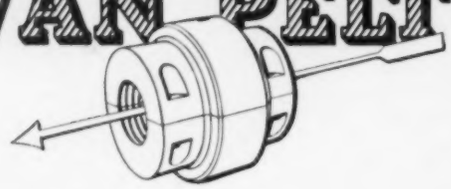

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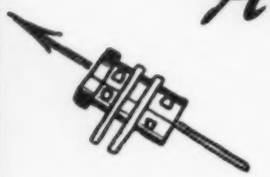

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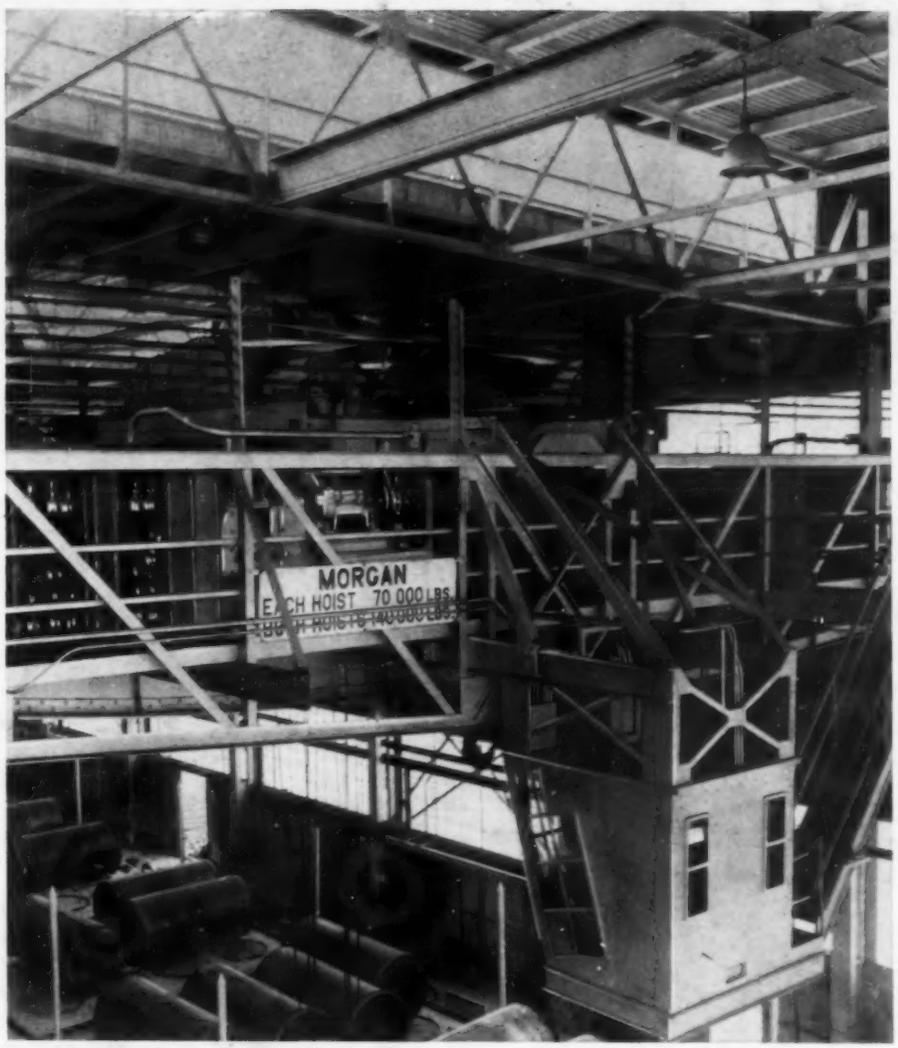
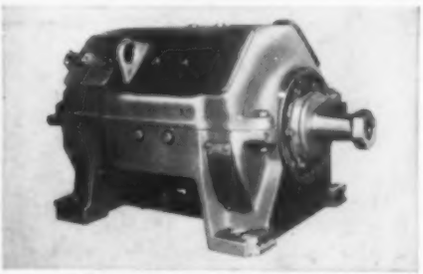
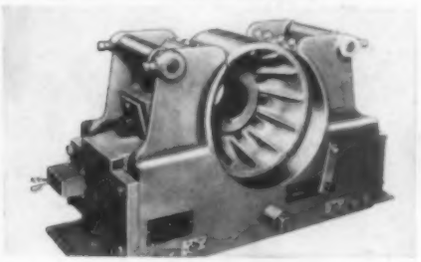


This 70-ton crane in a large steel mill—with a double hoist each rated 35 tons—is one of seven, all equipped with G-E crane drives, including Type MD-600 motors and hoist, bridge and trolley controls.

G-E crane control provides superior lowering performance for any hook load.



G-E MD-600 crane motors offer improved ventilation and maintenance ease.



G-E fast acting magnetic brake permits easy adjustment, requires less maintenance.

New control protects against overloads!

G-E hoist control panel solves tough motor maintenance problem; leads to choice of seven new G-E crane drives in large steel plant.

CO-ORDINATED

D-C CRANE DRIVES

Here's the kind of success story that's making General Electric crane control a heavy steel-mill favorite. In the box annealing building at this large mill, a 10-ton auxiliary hook on a mill crane was handling stacks of steel sheets to be put into annealing furnaces. Because the crane was frequently overloaded, two to four motor breakdowns a year had occurred over an eight-year period.

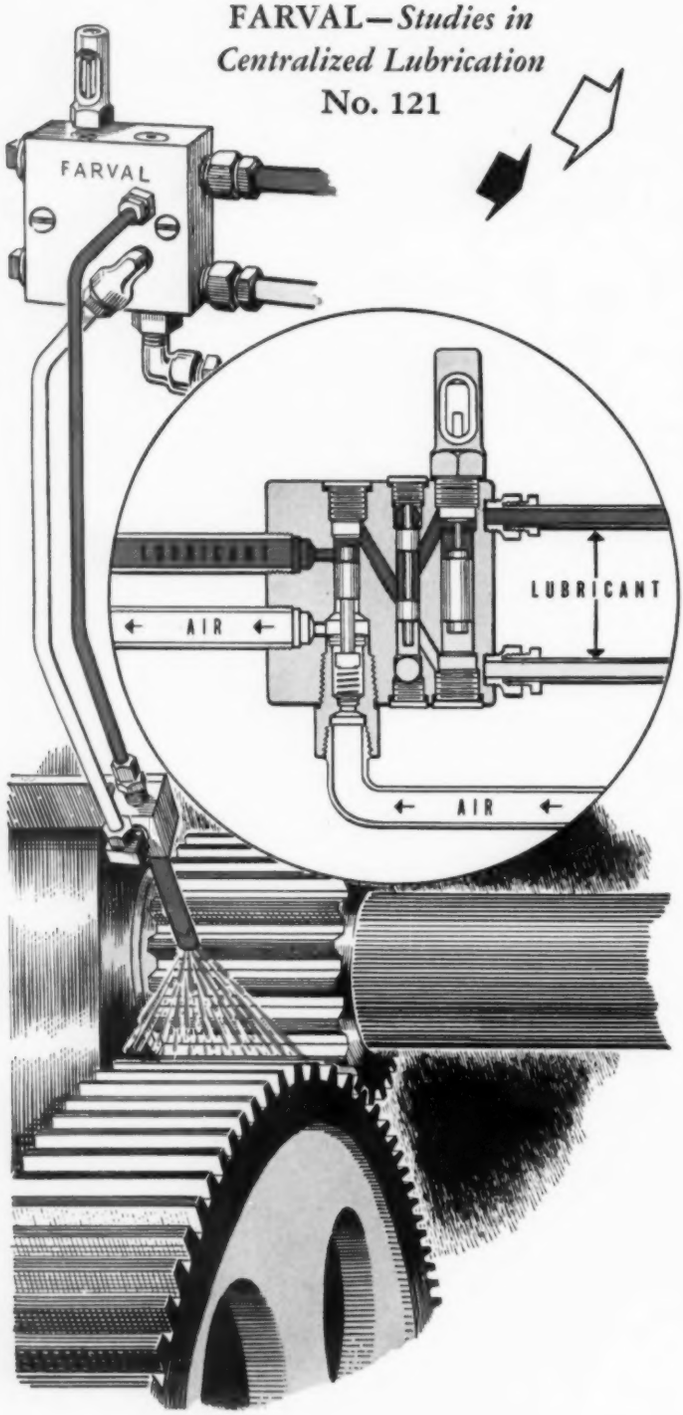
A G-E hoist control panel was installed in place of the previous magnetic control, providing safe and stable full-speed lowering operation for heavy overloads. Result: Motor breakdowns were cut to zero during the next 20-month period before the crane was retired from this severe duty. Furthermore, motor maintenance had been reduced by the lower commutating peaks and improved automatic deceleration. So impressed were the mill's operators by this outstanding performance that they selected G-E crane control, plus G-E MD-600 crane motors, for seven new crane installations (one shown above).

Is *yours* a tough crane drive problem? General Electric—with over 40 years of experience in working with crane builders—can help you solve it. Ask your G-E steel-mill specialist about it; meanwhile send for Bulletin GEA-5408 on G-E d-c crane drives. *General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

659-83

FARVAL—*Studies in Centralized Lubrication*
No. 121



New Farval Spray Valve

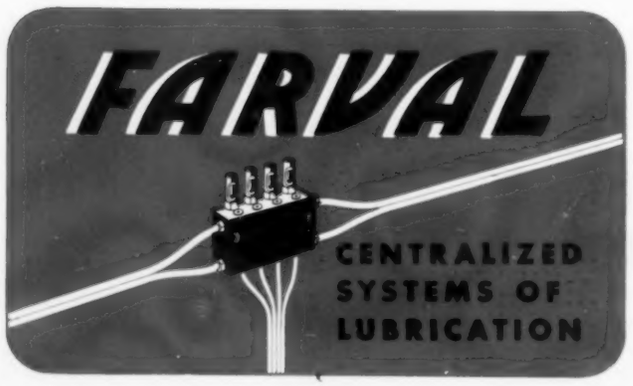
meters lubricants to slide surfaces and open gearing

CONTROLLED spraying of lubricant on open gearing, slide surfaces, etc., is practical with the new Farval Spray Valve.

By an ingenious adaptation of the familiar Farval Dualine Valve, either grease or oil is sprayed through a nozzle—on any desired area, in any desired amount, and at any desired interval. The new spray valve can be added at any point in a regular Farval Dualine System where compressed air is available—or a complete system may consist entirely of spray valves, served by either manual or automatic pumping unit.

Compressed air from the supply line is directed through the spray valve, which meters air to the delivery nozzle just as lubricant is metered. By unique arrangement, the lubricant valve also turns on and shuts off the air. Thus the quantity of air used is limited to the amount needed to spray each delivery of oil or grease, without exhausting or reducing pressure. Positive cut-off of lubricant by the Farval valve after each delivery eliminates bleeding from the nozzle—no waste, no mess, no trouble.

The Farval Spray Valve has been thoroughly tested in service and is now in use on a wide variety of machines and equipment. It has demonstrated its ability to supply lubricant efficiently and economically to open gearing, slide surfaces, in fact, wherever a standard Farval Dualine closed system is not readily adaptable.

Write for a copy of Farval Spray Valve Bulletin No. 60 for a full description, with illustrative diagrams and installation data. The Farval Corporation, 3278 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.